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HIGH ALTITUDE ATMOSPHERIC RADIATION TRANSPORT CALCULATIONS

Kaman Sciences Corporation
Colorado Springs, CO 80907

August 1976

Final Report

Approved for public release; distribution unlimited.

AIR FORCE WEAPONS LABORATORY
Air Force Systems Command
Kirtland Air Force Base, NM 87117

AFWL-TR-76-142

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This report contains the results of MORSAIR code Monte Carlo calculations of neutron and secondary gamma transport in a real two-dimensional variable density atmosphere. These data were generated so that an assessment could be made of the adequacy of mass integral scaling of uniform air calculations in defining radiation environments in the atmosphere. Unclassified fission and thermonuclear source spectra were used in the calculations at source altitudes from 5 to 80 kilometers. Silicon and tissue doses as well as the total fluences were calculated for both neutrons and secondary gammas. The $4\pi R^2$ dose

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data were fit to a seven-parameter equation in areal density at each sampling altitude of the MORSAIR run. The fit coefficients for these data and plots of the $4\pi R^2$ silicon doses and the silicon K-factors, defined as the ratio of the two-dimensional real air $4\pi R^2$ dose to the mass integral scaled $4\pi R^2$ dose, are presented.

PREFACE

The author wishes to express his appreciation to Capt. Raymond A. Shulstad, the AFWL Project Officer, for his interest and assistance in the generation and evaluation of the data contained in this report, and to Eleanor Berthelot of Kaman Sciences for her assistance in making the MORSAIR runs, processing and fitting the results, and plotting the data.

TABLE OF CONTENTS

ILLUSTRATIONS

ILLUSTRATIONS
(continued)

APPENDIX C

ILLUSTRATIONS
(continued)

ILLUSTRATIONS
(continued)

ILLUSTRATIONS
(continued)

ILLUSTRATIONS
(continued)

ILLUSTRATIONS
(continued)

ILLUSTRATIONS
(continued)

ILLUSTRATIONS
(continued)

ILLUSTRATIONS
(continued)

TABLES

TABLES (Continued)

SECTION I
INTRODUCTION

This report presents the results of fifteen computer runs made with the Kaman Sciences MORSAIR Monte Carlo computer program. These calculations were performed for the Air Force Weapons Laboratory (AFWL/SAT) under the direction of Capt. Raymond A. Shulstad.

The objective of this effort was to provide AFWL with a set of "real" two-dimensional atmospheric neutron and secondary gamma transport data for use in assessing the adequacy of mass scaled uniform air calculations. Previous studies at Kaman (ref. 1) and elsewhere (refs. 2, 3, 4) have indicated that large inaccuracies can result from scaling at high altitudes. The results presented in this report show the extent of these inaccuracies for two unclassified source spectra for both neutron and secondary gamma doses at altitudes from 5 to 80 kilometers.

For each MORSAIR run, the neutron and secondary gamma doses in silicon and tissue as well as the total particle fluence were calculated using a Monte Carlo technique at more than 150 detector locations about a point isotropic source in the atmosphere. The spectra used in these runs were an unclassified fission source and an unclassified thermonuclear source, both of which were provided by AFWL (ref. 5). In addition to a run in homogeneous air with each source spectrum for the purposes of verifying the tracking and scoring techniques of the code, eight runs with the fission source and five with the thermonuclear source were made in the variable density atmosphere. Section II of this report describes in detail the energy bins, spectra, altitudes and dose response functions used in the calculations.

In section III the homogeneous atmosphere neutron and secondary gamma transport data supplied by AFWL and used in this study are described. The two homogeneous atmosphere MORSAIR runs made for checkout purposes are discussed. Also, in section III, the statistical uncertainties of the Monte Carlo data, the method used to fit these data, and the accuracy of these fits are briefly described. Finally, the method used to determine the K-factor, defined as the ratio of the $4\pi R^2$ dose in real variable density air to the $4\pi R^2$ dose in homogeneous air, is described.

In section IV, a brief discussion of some of the more obvious trends of the results is presented. The qualitative dependence of the K-factor on the source and detector altitude, mass range, source spectrum, and dose response function is described. The two primary effects which cause deviations from the scaled homogeneous air results, namely a leakage effect and a mass distribution effect are also described.

A summary of the calculations performed for this study and the conclusions which may be drawn from these results are presented in section V.

In Appendix A, the tabulated fit coefficients of the one-dimensional ANISN $4\pi R^2$ dose data (used in defining the K-factors) are shown for the two source spectra. All of the $4\pi R^2$ doses have been plotted for both neutrons and secondary gammas and these are included in Appendix A. In Appendix B, the coefficients for the fits to the MORSAIR two-dimensional data are shown for each sampling altitude, dose response function, and particle type (neutron or secondary gamma). In Appendix C, plots of the fitted silicon dose data and the silicon K-factors for both neutrons and secondary gammas are shown for all 15 MORSAIR runs.

SECTION II
CALCULATIONS

1. THE MORSAIR PROGRAM

The Kaman Sciences MORSAIR program is an extensively modified version of the ORNL MORSE program (ref. 6) developed specifically for Monte Carlo calculations of radiation environments in a variable density atmosphere based on the 1962 Standard Atmosphere model (ref. 7). The multigroup cross section module of MORSE was used without modification, but the geometry and random walk modules were revised and a new scoring routine using an "extended path" or expectation boundary crossing estimator for scoring in concentric annular rings was added. In previous studies, the MORSAIR code has been used for calculating radiation environments at source altitudes from 20 to 65 kilometers. The results of those calculations have been checked against other Kaman real air transport codes, and codes from other agencies (ref. 8). It has been found to be a useful code for predicting radiation environments at high altitudes where traditional methods of scaling uniform atmosphere results are inadequate.

The latest version of MORSAIR was written for use on the CDC 7600 computer and utilizes the fast access large core capability of that machine so that very large problems in terms of storage requirements can be efficiently handled by the code. In this study the time integrated neutron and secondary gamma doses and associated standard deviations were calculated for 58 energy groups at as many as 190 detectors spaced about the source. The differential energy spectra were recorded on magnetic tape so that doses other than those shown in this report can be calculated.

Earth curvature effects were not included in the calculations, because these effects have been shown to be negligible at the altitudes and ranges of the calculations performed for this study (ref. 9).

2. INPUT PARAMETERS

The air cross sections used in the MORSAIR runs were the DLC-31 multigroup set distributed by the Radiation Shielding Information Center at ORNL (ref. 10). These cross sections were prepared from ENDF/B-IV data using a fission spectrum weighting function. A third order (P3) Legendre expansion was used to represent the angular variation of the cross sections. The nitrogen and oxygen cross sections were mixed to form the macroscopic cross sections of air with the following composition (ref. 5):

Density:	1.11 mg/cm^3
Volume percentages:	79 percent nitrogen 21 percent oxygen
Number densities:	3.6609×10^{19} nitrogen atoms/cm^3 9.7316×10^{18} oxygen atoms/cm^3

A copy of these cross sections was provided to Kaman by AFWL. The 37 neutron and 21 secondary gamma energy groups of the DLC-31 cross section set are shown in table 1. In table 2, the fraction of source neutrons in each of the groups is shown for the two unclassified spectra used in the calculations.

Three different response functions were used to weight the MORSAIR energy spectrum at each detector. Table 3 shows the neutron silicon and tissue dose response functions, and table 4 shows these response functions for the secondary gamma groups. The response functions shown in tables 3 and 4 were provided by AFWL (ref. 5). In addition to the silicon and tissue doses, the total number fluence was also calculated for both neutrons and secondary gammas.

TABLE 1

DLC-31 ENERGY GROUP STRUCTURE

GROUP	NEUTRON ENERGY (MEV)	GROUP	GAMMA ENERGY (MEV)
1	1.9640E+01 - 1.6905E+01	38	1.4000E+01 - 1.0000E+01
2	1.6905E+01 - 1.4918E+01	39	1.0000E+01 - 8.0000E+00
3	1.4918E+01 - 1.4191E+01	40	8.0000E+00 - 7.0000E+00
4	1.4191E+01 - 1.3840E+01	41	7.0000E+00 - 6.0000E+00
5	1.3840E+01 - 1.2840E+01	42	6.0000E+00 - 5.0000E+00
6	1.2840E+01 - 1.2214E+01	43	5.0000E+00 - 4.0000E+00
7	1.2214E+01 - 1.1052E+01	44	4.0000E+00 - 3.0000E+00
8	1.1052E+01 - 1.0000E+01	45	3.0000E+00 - 2.5000E+00
9	1.0000E+01 - 9.0484E+00	46	2.5000E+00 - 2.0000E+00
10	9.0484E+00 - 8.1873E+00	47	2.0000E+00 - 1.5000E+00
11	8.1873E+00 - 7.4082E+00	48	1.5000E+00 - 1.0000E+00
12	7.4082E+00 - 6.3763E+00	49	1.0000E+00 - 7.0000E-01
13	6.3763E+00 - 4.9659E+00	50	7.0000E-01 - 4.5000E-01
14	4.9659E+00 - 4.7237E+00	51	4.5000E-01 - 3.0000E-01
15	4.7237E+00 - 4.0657E+00	52	3.0000E-01 - 1.5000E-01
16	4.0657E+00 - 3.0119E+00	53	1.5000E-01 - 1.0000E-01
17	3.0119E+00 - 2.3852E+00	54	1.0000E-01 - 7.0000E-02
18	2.3852E+00 - 2.3069E+00	55	7.0000E-02 - 4.5000E-02
19	2.3069E+00 - 1.8268E+00	56	4.5000E-02 - 3.0000E-02
20	1.8268E+00 - 1.1080E+00	57	3.0000E-02 - 2.0000E-02
21	1.1080E+00 - 5.5023E-01	58	2.0000E-02 - 1.0000E-02
22	5.5023E-01 - 1.5764E-01		
23	1.5764E-01 - 1.1109E-01		
24	1.1109E-01 - 5.2475E-02		
25	5.2475E-02 - 2.4788E-02		
26	2.4788E-02 - 2.1875E-02		
27	2.1875E-02 - 1.0333E-02		
28	1.0333E-02 - 3.3546E-03		
29	3.3546E-03 - 1.2341E-03		
30	1.2341E-03 - 5.8294E-04		
31	5.8294E-04 - 1.0130E-04		
32	1.0130E-04 - 2.9023E-05		
33	2.9023E-05 - 1.0677E-05		
34	1.0677E-05 - 3.0590E-06		
35	3.0590E-06 - 1.1254E-06		
36	1.1254E-06 - 4.1400E-07		
37	4.1400E-07 - 1.0000E-11		

TABLE 2

NEUTRON SOURCES

GROUP	NEUTRON ENERGY (MEV)	THERMONUCLEAR	FISSION
1	1.9640E+01 - 1.6905E+01	0.	0.
2	1.6905E+01 - 1.4918E+01	0.	0.
3	1.4918E+01 - 1.4191E+01	1.8870E-02	0.
4	1.4191E+01 - 1.3840E+01	9.3400E-03	0.
5	1.3840E+01 - 1.2840E+01	2.6620E-02	0.
6	1.2840E+01 - 1.2214E+01	1.6660E-02	0.
7	1.2214E+01 - 1.1052E+01	1.6870E-02	0.
8	1.1052E+01 - 1.0000E+01	1.2400E-02	0.
9	1.0000E+01 - 9.0484E+00	7.4800E-03	3.8400E-03
10	9.0484E+00 - 8.1873E+00	6.8200E-03	3.5000E-03
11	8.1873E+00 - 7.4082E+00	6.7800E-03	5.3900E-03
12	7.4082E+00 - 6.3763E+00	1.0300E-02	7.3500E-03
13	6.3763E+00 - 4.9659E+00	1.8070E-02	1.8370E-02
14	4.9659E+00 - 4.7237E+00	3.6200E-03	3.2500E-03
15	4.7237E+00 - 4.0657E+00	1.2430E-02	8.4700E-03
16	4.0657E+00 - 3.0119E+00	2.6040E-02	5.5000E-02
17	3.0119E+00 - 2.3852E+00	2.3730E-02	3.2440E-02
18	2.3852E+00 - 2.3069E+00	3.7500E-03	1.0580E-02
19	2.3069E+00 - 1.8268E+00	2.5640E-02	9.7240E-02
20	1.8268E+00 - 1.1080E+00	6.4450E-02	1.4677E-01
21	1.1080E+00 - 5.5023E-01	8.8490E-02	2.1567E-01
22	5.5023E-01 - 1.5764E-01	9.1380E-02	1.5018E-01
23	1.5764E-01 - 1.1109E-01	1.1630E-02	1.9300E-02
24	1.1109E-01 - 5.2475E-02	1.1078E-01	1.2098E-01
25	5.2475E-02 - 2.4788E-02	5.4000E-02	5.7290E-02
26	2.4788E-02 - 2.1875E-02	5.6800E-03	6.0000E-03
27	2.1875E-02 - 1.0333E-02	9.2640E-02	2.4000E-02
28	1.0333E-02 - 3.3546E-03	1.1627E-01	1.4400E-02
29	3.3546E-03 - 1.2341E-03	7.3820E-02	0.
30	1.2341E-03 - 5.8294E-04	2.3240E-02	0.
31	5.8294E-04 - 1.0130E-04	2.0280E-02	0.
32	1.0130E-04 - 2.9023E-05	1.9000E-03	0.
33	2.9023E-05 - 1.0677E-05	0.	0.
34	1.0677E-05 - 3.0590E-06	0.	0.
35	3.0590E-06 - 1.1254E-06	0.	0.
36	1.1254E-06 - 4.1400E-07	0.	0.
37	4.1400E-07 - 1.0000E-11	0.	0.

TABLE 3

NEUTRON DOSE RESPONSE FUNCTIONS

GROUP	NEUTRON ENERGY (MEV)	TISSUE DOSE RAD/(N/CM2)	SILICON DOSE RAD/(N/CM2)
1	1.9640E+01 - 1.6905E+01	8.6724E-09	1.9106E-09
2	1.6905E+01 - 1.4918E+01	7.4190E-09	1.7792E-09
3	1.4918E+01 - 1.4191E+01	6.8115E-09	1.6818E-09
4	1.4191E+01 - 1.3840E+01	6.5447E-09	1.6231E-09
5	1.3840E+01 - 1.2840E+01	6.1473E-09	1.5144E-09
6	1.2840E+01 - 1.2214E+01	5.9548E-09	1.3851E-09
7	1.2214E+01 - 1.1052E+01	5.8936E-09	1.2370E-09
8	1.1052E+01 - 1.0000E+01	5.5508E-09	1.0530E-09
9	1.0000E+01 - 9.0484E+00	5.2882E-09	8.7897E-10
10	9.0484E+00 - 8.1873E+00	5.0473E-09	7.9629E-10
11	8.1873E+00 - 7.4082E+00	5.0045E-09	7.8141E-10
12	7.4082E+00 - 6.3763E+00	4.7595E-09	4.7092E-10
13	6.3763E+00 - 4.9659E+00	4.4831E-09	2.1394E-10
14	4.9659E+00 - 4.7237E+00	4.2531E-09	1.8267E-10
15	4.7237E+00 - 4.0657E+00	4.1711E-09	1.4195E-10
16	4.0657E+00 - 3.0119E+00	3.9784E-09	1.0582E-10
17	3.0119E+00 - 2.3852E+00	3.3905E-09	1.0006E-10
18	2.3852E+00 - 2.3069E+00	3.1377E-09	8.2995E-11
19	2.3069E+00 - 1.8268E+00	3.0345E-09	9.4778E-11
20	1.8268E+00 - 1.1080E+00	2.6393E-09	6.5328E-11
21	1.1080E+00 - 5.5023E-01	2.0570E-09	4.9785E-11
22	5.5023E-01 - 1.5764E-01	1.3330E-09	3.1515E-11
23	1.5764E-01 - 1.1109E-01	7.6228E-10	1.7897E-12
24	1.1109E-01 - 5.2475E-02	5.4890E-10	2.8022E-12
25	5.2475E-02 - 2.4788E-02	3.1164E-10	1.2327E-12
26	2.4788E-02 - 2.1875E-02	2.0739E-10	7.9084E-13
27	2.1875E-02 - 1.0333E-02	1.4662E-10	5.8930E-13
28	1.0333E-02 - 3.3546E-03	6.6143E-11	2.9804E-13
29	3.3546E-03 - 1.2341E-03	2.2758E-11	1.0498E-13
30	1.2341E-03 - 5.8294E-04	9.1315E-12	4.3305E-14
31	5.8294E-04 - 1.0130E-04	3.6632E-12	1.4421E-14
32	1.0130E-04 - 2.9023E-05	1.1759E-12	4.5895E-15
33	2.9023E-05 - 1.0677E-05	1.1095E-12	3.9377E-15
34	1.0677E-05 - 3.0590E-06	1.6117E-12	5.6286E-15
35	3.0590E-06 - 1.1254E-06	2.7416E-12	9.4023E-15
36	1.1254E-06 - 4.1400E-07	4.4570E-12	1.5390E-14
37	4.1400E-07 - 1.0000E-11	1.1238E-11	7.4244E-13

TABLE 4

GAMMA DOSE RESPONSE FUNCTIONS

GROUP	GAMMA ENERGY (MEV)	TISSUE DOSE RAD/(N/CM2)	SILICON DOSE RAD/(N/CM2)
1	1.4000E+01 - 1.0000E+01	2.7431E-09	3.4184E-09
2	1.0000E+01 - 8.0000E+00	2.2564E-09	2.5712E-09
3	8.0000E+00 - 7.0000E+00	1.9840E-09	2.1612E-09
4	7.0000E+00 - 6.0000E+00	1.7922E-09	1.8991E-09
5	6.0000E+00 - 5.0000E+00	1.5928E-09	1.6367E-09
6	5.0000E+00 - 4.0000E+00	1.3897E-09	1.3835E-09
7	4.0000E+00 - 3.0000E+00	1.1803E-09	1.1335E-09
8	3.0000E+00 - 2.5000E+00	1.0098E-09	9.4334E-10
9	2.5000E+00 - 2.0000E+00	8.8320E-10	8.2034E-10
10	2.0000E+00 - 1.5000E+00	7.4281E-10	6.8343E-10
11	1.5000E+00 - 1.0000E+00	5.8030E-10	5.2846E-10
12	1.0000E+00 - 7.0000E-01	4.2393E-10	3.8505E-10
13	7.0000E-01 - 4.5000E-01	2.9695E-10	2.7122E-10
14	4.5000E-01 - 3.0000E-01	1.9283E-10	1.7772E-10
15	3.0000E-01 - 1.5000E-01	1.0770E-10	1.0459E-10
16	1.5000E-01 - 1.0000E-01	4.9383E-11	6.8510E-11
17	1.0000E-01 - 7.0000E-02	3.4315E-11	7.9854E-11
18	7.0000E-02 - 4.5000E-02	2.9479E-11	1.4543E-10
19	4.5000E-02 - 3.0000E-02	4.3750E-11	3.4411E-10
20	3.0000E-02 - 2.0000E-02	9.6647E-11	8.2679E-10
21	2.0000E-02 - 1.0000E-02	3.2504E-10	2.6493E-09

3. DESCRIPTION OF RUNS

A summary of the 15 MORSAIR runs made for this study is shown in table 5. In addition to the homogeneous atmosphere runs, eight runs were made using the fission source in real air at altitudes from 5 to 80 kilometers, and five thermonuclear source runs were made at altitudes from 20 to 80 kilometers. A minimum of 50,000 initial neutron histories were followed for each run, and the secondary gamma production rate was adjusted so that approximately the same number of gammas was produced in each run. For the lower altitude and homogeneous runs, the computer time required for 50,000 histories was greater than 30 minutes of CDC 7600 execution time. At the higher altitudes an appreciable number of the neutrons and secondary gammas escape out the "top" of the atmosphere after a few scatterings so that as many as 150,000 initial neutrons and approximately the same number of secondary gammas could be followed in less than 30 minutes.

A time cutoff of 20 seconds was used for each neutron history. This ensured that almost no neutrons were lost because of this cutoff.

The atmosphere model used in MORSAIR provides for a continuously varying density from sea level to 200 kilometers and very closely approximates the 1962 Standard Atmosphere model (ref. 7). Above 200 kilometers, a void is assumed and particles reaching this altitude are allowed to escape. The lateral extent of the atmosphere varied with each run to provide a large buffer beyond the last detectors of interest at each sampling altitude. This ensured that lateral leakage effects on the results would be negligible. Any particle reaching the ground (which only a very few did) was terminated.

TABLE 5

MORSAIR RUNS

Number	Source	Source Altitude (km)	Number of Detectors	Neutron Histories	CDC 7600 Computer Time (Minutes)
1	Fission	Homogeneous	190	50000	39
2	Fission	5	165	50000	42
3	Fission	10	172	50000	36
4	Fission	15	171	50000	33
5	Fission	20	151	50000	31
6	Fission	30	156	96000	30
7	Fission	40	152	150000	30
8	Fission	60	184	150000	20
9	Fission	80	183	150000	21
10	Thermonuclear	Homogeneous	190	50000	37
11	Thermonuclear	20	151	50000	29
12	Thermonuclear	30	156	93500	30
13	Thermonuclear	40	152	150000	30
14	Thermonuclear	60	184	150000	23
15	Thermonuclear	80	183	150000	20

Particle histories were terminated primarily because they escaped from the top of the atmosphere or their weight became so small that they could not contribute a significant score at any detector.

SECTION III
RESULTS

1. HOMOGENEOUS ONE-DIMENSIONAL TRANSPORT DATA

The one-dimensional homogeneous air neutron and secondary gamma transport data used as a basis of comparison in this report were provided by AFWL (ref. 12). These data were generated by appropriate source spectrum weighting of Murphy's fits to Burgio's ANISN results (ref. 11). The resulting $4\pi R^2$ dose data were then fit to the equation:

$$\ln \left[4\pi R^2 \text{ Dose}\right] = A + Bx + Cx^2 + Dx^{3/2} + Ex^{1/2} + Fx^{1/3} + G \ln x$$
$$\text{for } 0.1 < x < 300 \text{ gm/cm}^2$$

where x is the mass range* of air or areal density in gm/cm^2. The seven coefficients representing the fits to the neutron and secondary gamma homogeneous atmosphere data are tabulated in Appendix A for the two spectra and three dose response functions used in this study.

For very small areal densities, between 0.0 and 0.1 gm/cm^2 of air which are of interest particularly at very high altitudes, a linear interpolation between the fitted ANISN $4\pi R^2$ dose at 0.1 gm/cm^2 and the uncollided $4\pi R^2$ dose (i.e., the sum over all energy groups of the products of the source fractions and dose response functions) at zero mass range was used to find the $4\pi R^2$ neutron doses. This method is commonly used in mass integral scaling codes to define atmospheric neutron environments at small mass ranges. A similar interpolation technique was used for the secondary gammas between zero and 0.1 gm/cm^2 of air, except in this case a $4\pi R^2$ dose value of zero was used at zero mass range.

*See footnote on page 35 for a definition of mass range.

The same energy groups, cross sections, sources, and dose response functions described earlier for the MORSAIR runs were used in the uniform air calculations.

2. MORSAIR VERIFICATION IN HOMOGENEOUS AIR

An option exists in the MORSAIR code to replace the variable density atmosphere model with a homogeneous atmosphere model. As an initial check on the scoring and tracking techniques employed in the code, one run for both the thermonuclear and the fission source spectrum was made using this option. It was anticipated that the results of such a run would agree with the one-dimensional ANISN infinite air results provided by AFWL from Burgio's calculations using the same spectra and response functions. Figures C-1 and C-3 of Appendix C show that for all sampling altitudes the difference between the fits of the ANISN homogeneous data and fits of the two-dimensional MORSAIR homogeneous data is less than 15 percent out to 100 gm/cm^2 and within 25 percent out to 200 gm/cm^2 for a fission source. Similar results for a thermonuclear source are shown in figures C-49 and C-51 of Appendix C. It should be emphasized that the solid lines shown in these and other figures of Appendix C represent the fitted one-dimensional homogeneous air ANISN data, and the points are calculated from the fits of the MORSAIR data. It should also be pointed out that in the figures immediately following those mentioned above, namely figures C-2, C-4, C-50, and C-52 of Appendix C, the K-factors presented are actually ratios of fits of the homogeneous MORSAIR data to the ANISN data. All of the data in Appendix C is presented in this manner, i.e., the fitted homogeneous and real air data are shown first followed by the K-factors calculated from this data for each MORSAIR run. The differences between the ANISN and MORSAIR results for a homogeneous atmosphere are within the statistical

uncertainties of the MORSAIR data for these runs, and it was concluded that the MORSAIR tracking and scoring methods were correct.

3. STATISTICAL UNCERTAINTIES IN THE MORSAIR DATA

At the lowest source altitudes, the 50,000 neutron and secondary gamma histories resulted in standard deviations in the total doses of less than 15 percent out to 100 gm/cm^2, and less than 25 percent to 200 gm/cm^2 in most cases. At source altitudes above 20 kilometers, the expectation boundary crossing scoring method is more efficient, and the statistical uncertainties in the data were somewhat less.

4. FITS TO THE MORSAIR DATA

To smooth the MORSAIR Monte Carlo results and to reduce the quantity of data to a more usable form consistent with the one-dimensional results, all of the $4\pi R^2$ doses were fit to the same seven parameter equation in areal density described above. For the MORSAIR data, it was found that dropping the last term, G ln x, did not affect the accuracy of the fits significantly and in some cases resulted in a slight improvement in the fit. For this reason, only six coefficients are used in the fits to the MORSAIR data shown in Appendix B.

The technique used to fit the data was a standard linear weighted least squares technique such as described in reference 13. The fitting method, it should be noted, was applied to the logarithm of the $4\pi R^2$ dose data where each data point was given a weight inversely proportional to the square of the logarithmic uncertainty in the MORSAIR data point. Any data point with a standard deviation greater than 50 percent was deleted before the fit was applied. The number of points removed for this reason was small for areal densities less than 200 gm/cm^2.

The fit coefficients for each run are tabulated in Appendix B. In addition, the range (in terms of minimum and maximum areal densities) over which the fit applies is shown. The last column in the tables, "RMS PCT DIFF", is the weighted root mean square percentage difference between the fit data and the actual MORSAIR data, i.e.,

$$\text{"RMS PCT DIFF"} = \sqrt{\frac{\Sigma_i \; W_i \; Y_i^{\,2}}{\Sigma_i W_i}} \quad \times 100$$

$$\text{where } Y_i = \ln \left[\frac{4\pi R^2 \text{ actual MORSAIR dose}}{4\pi R^2 \text{ fit MORSAIR dose}} \right]$$

and the weight, W_i, was defined as:

$$W_i = \left[\ln \; (1 + \sigma_i) \right]^{-2}$$

where σ_i = fractional standard deviation of the MORSAIR dose.

As an example of the adequacy of the six parameter fit to represent the data, figure 1 shows both the actual MORSAIR data points and the values calculated from the fit for coaltitude neutron silicon doses from a thermonuclear source at 20 and 40 kilometers. Figure 2 shows the MORSAIR data points and the fit for the secondary gamma silicon dose. In general, it was found that this fitting technique resulted in a reasonably good representation of the actual data.

5. THE K-FACTOR

The adequacy of mass integral scaling of uniform air results to define real air environments can be conveniently described in terms of a K-factor which was first used by

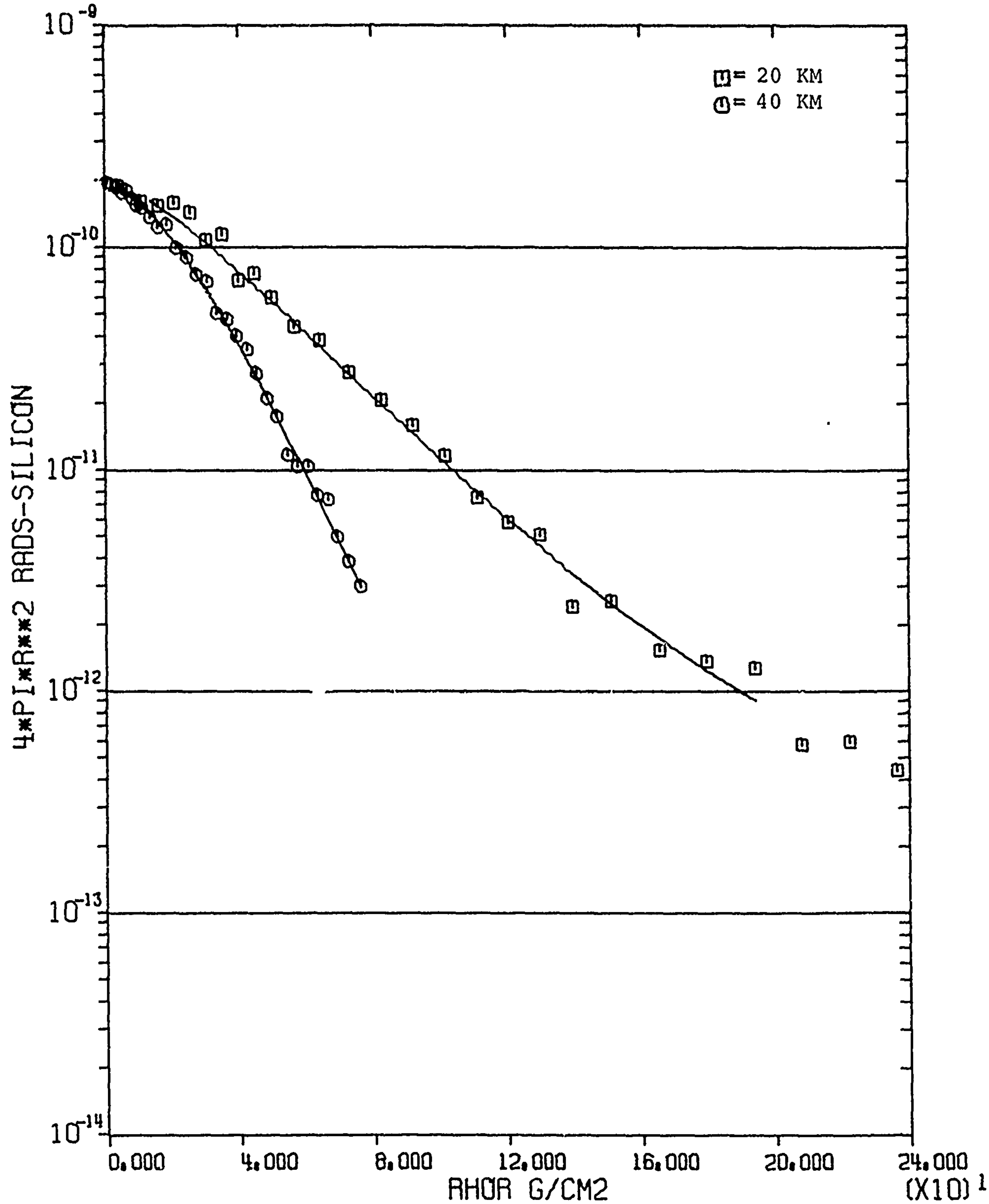

Figure 1. MORSAIR Data Points and the Fit to the Data Points for $4\pi R^2$ Neutron Silicon Dose, Coaltitude Sampling from 20 and 40 km Thermonuclear Sources

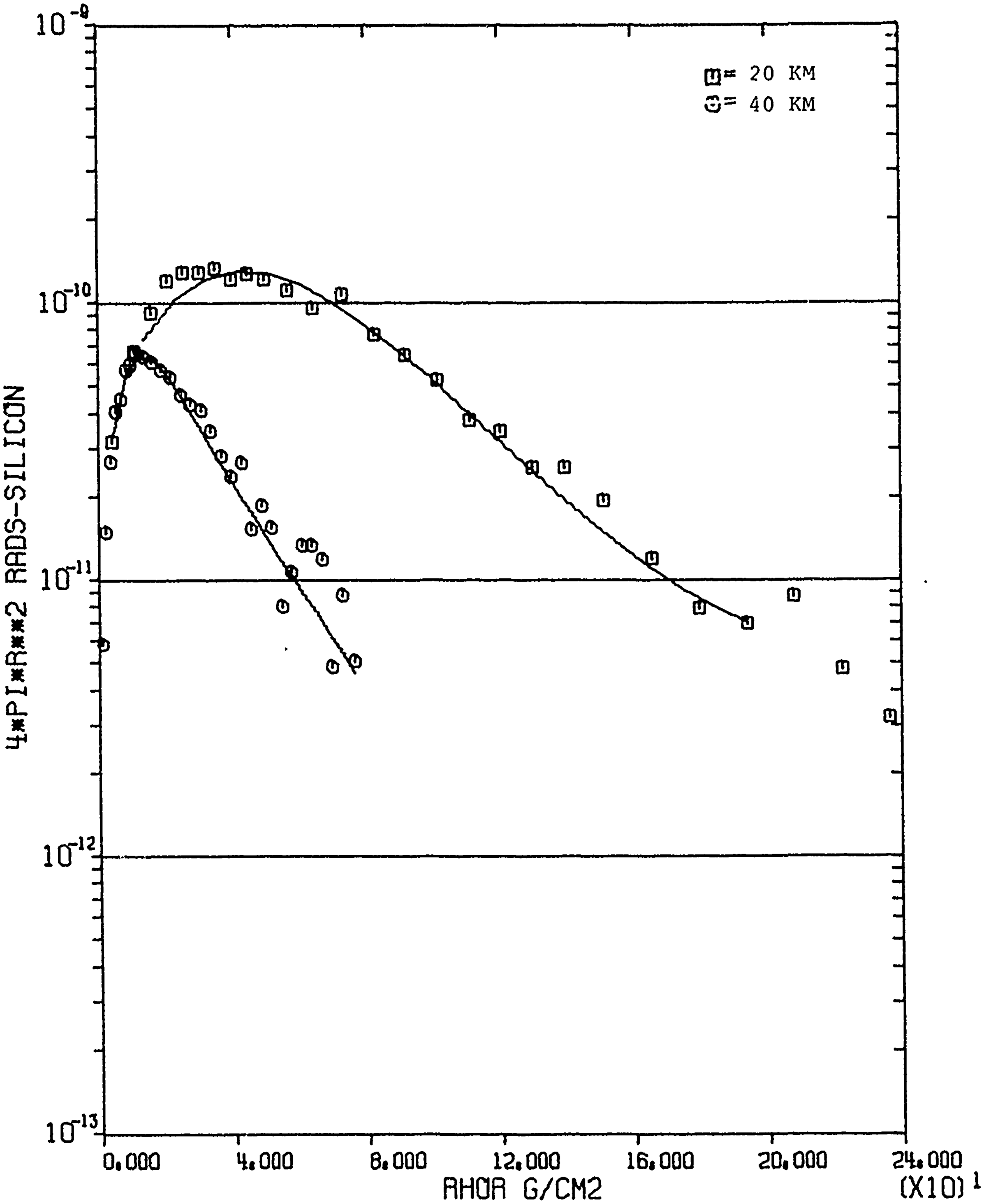

Figure 2. MORSAIR Data Points and the Fit to the Data Points for $4\pi R^2$ Secondary Gamma Silicon Dose, Coaltitude Sampling from 20 and 40 km Thermonuclear Sources

Marcum in his early high altitude transport studies (refs. 2, 3). The K-factor as used in this report is defined as

$$\text{K-factor} = \left[\frac{\text{The } 4\pi R^2 \text{ dose at a detector as calculated in a "real" variable density atmosphere (from fits to MORSAIR data in this case)}}{\text{The } 4\pi R^2 \text{ dose received at the detector as calculated in homogeneous one-dimensional infinite air (from fits to the ANISN data in this case)}}\right]$$

The K-factor, then, is a direct measure of the error associated with mass integral scaling of infinite air data due to the variable density nature of the atmosphere and can be used as multiplicative correction factor to the scaled data. A K-factor of 0.5, for example, indicates that in the real atmosphere the dose received is only one half of the dose that would be predicted by scaling methods.

Marcum's early studies and more recently those of Keith (ref. 1) and others (refs. 14, 15) have shown that the neutron K-factor is a function of source altitude, detector altitude, slant range, source energy, and the dose response function. The neutron K-factor, it has been shown, can vary from less than .1 at high source altitudes to greater than 5 for detectors below the source and at large areal densities. It is believed that while this study is more extensive in terms of the number of calculations performed and the range of altitudes and mass ranges covered, the data trends shown in this report for neutrons are in substantial agreement with the earlier data of Marcum and Keith. No previous attempts to calculate the transport of secondary gammas in a real atmosphere have been published.

Although there are many situations of practical interest in which the K-factor is near unity so that scaling results in small errors, there are also situations in which large

errors can result from neglecting variable density effects. It is hoped that the data presented in this report will allow a user to recognize those situations where scaling may be inaccurate.

In Appendix C, the $4\pi R^2$ silicon dose and the silicon K-factor are plotted as a function of areal density for each of the MORSAIR runs. The trends of the silicon dose K-factors, as will be shown in section IV, are similar to those of the tissue dose and the total fluence K-factors so that in the interest of brevity, only the silicon dose and K-factor plots are shown.

Definition of Mass Range (RHOR):

In homogeneous air,

$$\mathrm{RHOR} = \rho(zs)R$$

and in 2-D real air,

$$\mathrm{RHOR} = \int_0^R \rho(z)\,dR$$

where

$\rho(z)$ = density as a function of altitude;

$\rho(zs)$ = density at source altitude (zs);

R = slant range between the source and a receiver point.

SECTION IV
DISCUSSION

The K-factor, as defined previously, can be considered as a multiplicative correction factor to be applied to the scaled homogeneous air dose to account for the transport of neutrons and secondary gammas in the real variable density atmosphere. Since many computer codes used to predict neutron and secondary gamma environments in the atmosphere (such as ATR and SMAUG) use the method of mass integral scaling of homogeneous air transport data, it is believed that presenting the MORSAIR results in terms of K-factors allows a direct means of assessing the accuracy of these codes for source spectra similar to those used in this study.

The results of this study show that the K-factor is a complicated function of several parameters. In this section the dependence of the K-factor and therefore the validity of mass integral scaling of homogeneous air data on these parameters is described in a qualitative manner. A detailed explanation of the differences in the transport of neutrons and secondary gammas in homogeneous air and in a variable density atmosphere was beyond the scope of this effort.

1. K-FACTOR DEPENDENCE ON ALTITUDE AND MASS RANGE

In general as the source or detector altitude increases, more particles escape out the top of the atmosphere. Therefore, when compared to the mass integral scaled dose, the dose in a real atmosphere can be substantially less. This leakage effect has been demonstrated in many high altitude transport calculations. Figure 3 shows the coaltitude neutron K-factors for silicon at several source altitudes as calculated by MORSAIR for a fission source. For a detector at 40 gm/cm^2 from the source, the neutron K-factor is nearly unity for sources below

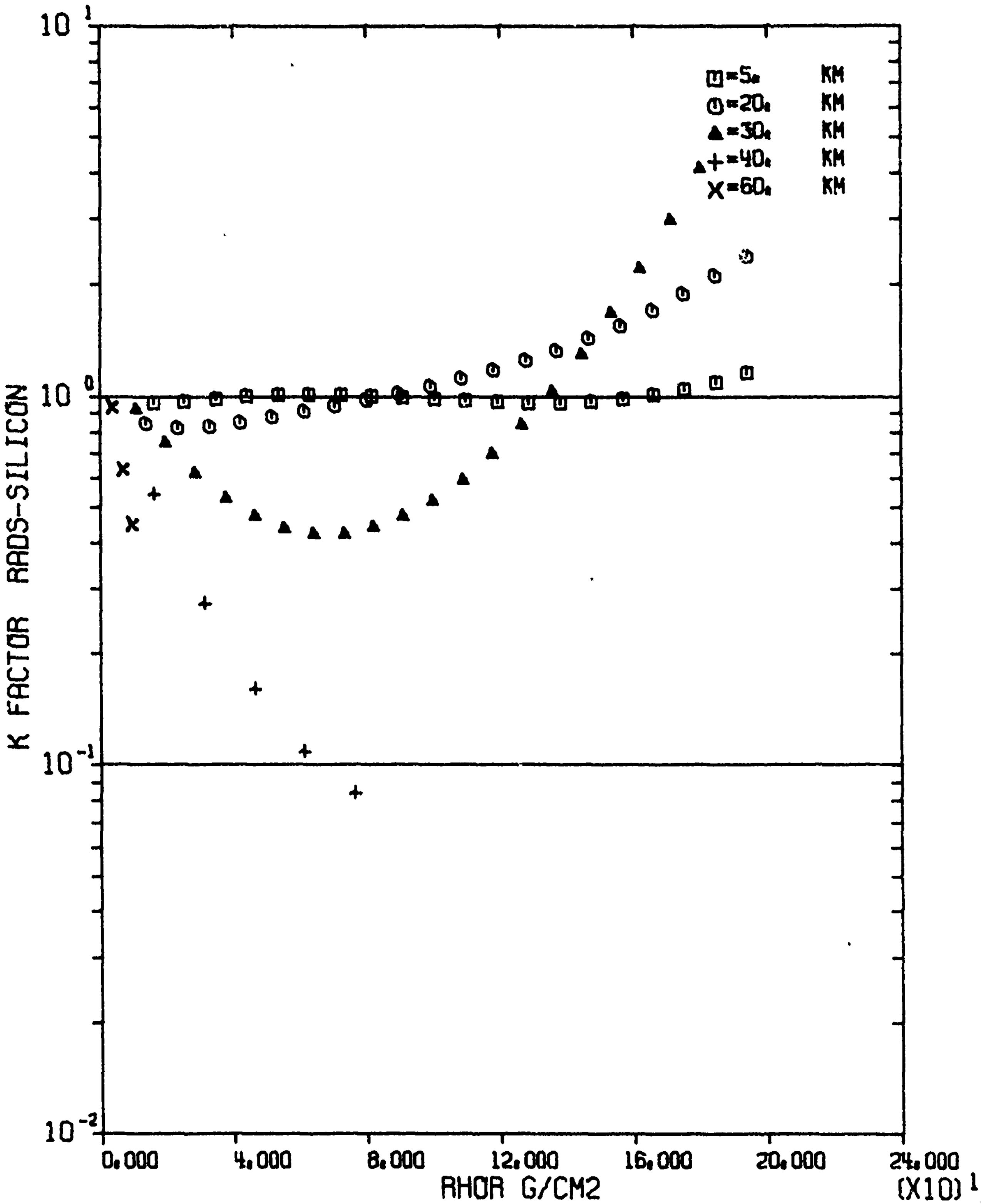

Figure 3. Neutron Coaltitude Silicon K-factors at Several Source Altitudes for a Fission Source

20 kilometers, decreases to about 0.5 for a source at 30 kilometers, and is less than 0.2 for a 40 kilometer source altitude. The secondary gamma silicon K-factors exhibit a similar behavior as shown in figure 4, except the K-factors fall off even more at the higher source altitudes. Similar trends in the K-factors occur if the source altitude remains constant and the detector altitude changes as shown in figures C-27 and C-29 of Appendix C, for example.

In addition to this expected decrease with source and detector altitude due to leakage effects, it is also obvious from figures 3 and 4 that the K-factors are a strong function of the amount of air (areal density) between the source and detector. For detectors coaltitude with the source, the K-factor at high altitudes decreases monotonically as the areal density increases, but at the 20 and 30 kilometer source altitudes, the K-factor curve is more complicated.

Figure 3 shows that for these source altitudes, the neutron K-factor initially decreases with mass range as it does at higher altitudes due to leakage of particles from the atmosphere. At mass ranges of 80 to 100 gm/cm^2, however, the neutron K-factor begins to increase and at very large mass ranges it can be greater than 4 indicating that at these large ranges the actual dose can be more than four times the dose that is predicted by scaling the homogeneous transport data. This dose enhancement has been observed in earlier results (ref. 1), and is apparently due to the fact that a substantial number of the neutrons which arrive at these detectors at large mass ranges travel large distances in the lower density air above the detector and thus traverse less air than is predicted by the simple straight line mass integral between the source and the detector. They are therefore attenuated less than what would be predicted by the scaled

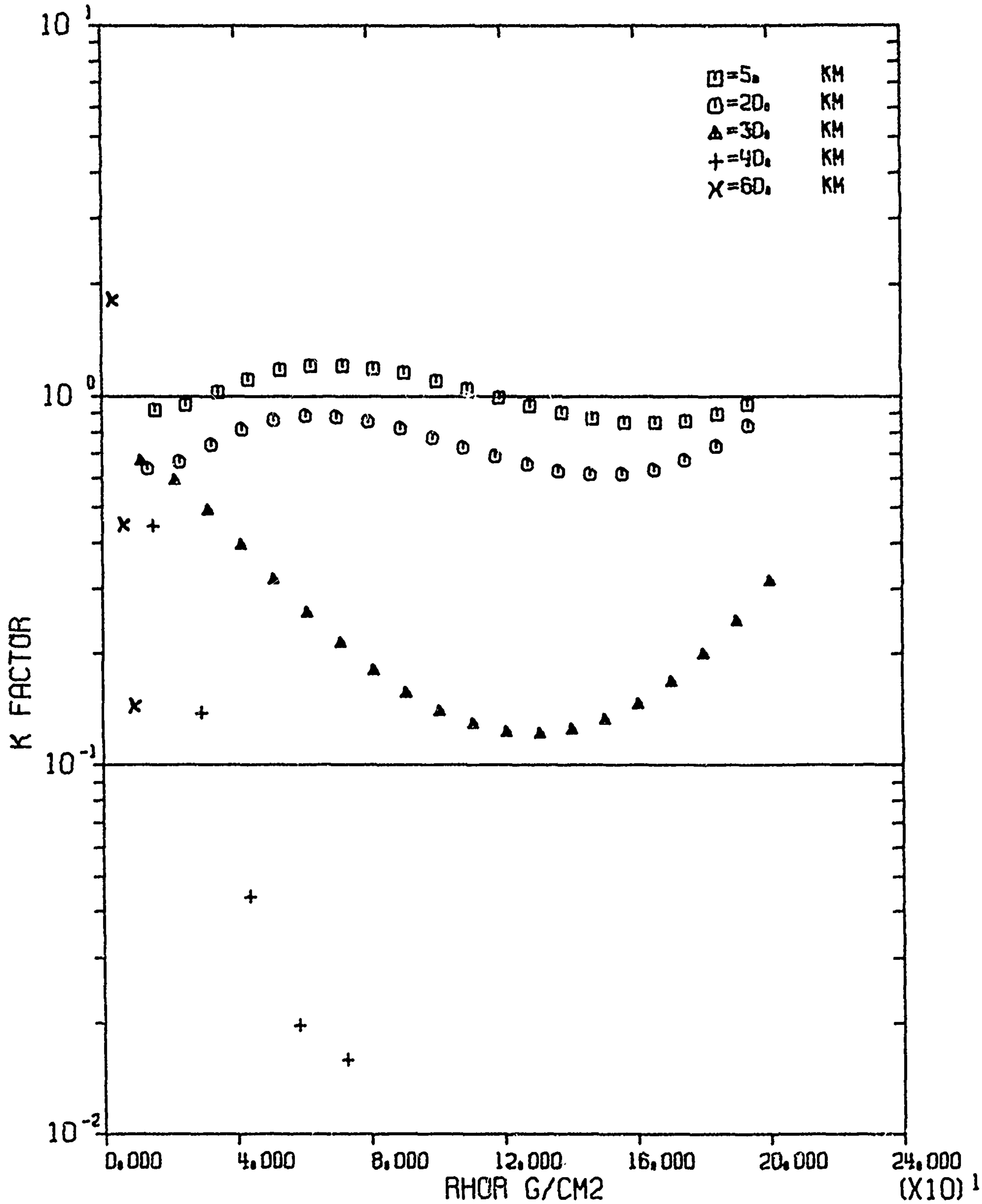

Figure 4. Secondary Gamma Coaltitude Silicon K-factors at Several Source Altitudes for a Fission Source

homogeneous atmosphere results. This effect has been referred to as a "short circuiting" (ref. 15) or "mass distribution" (ref. 14) effect. While it is most apparent for detectors coaltitude and below the source at large mass ranges, this effect also occurs to a lesser extent for detectors above the source at large distances as is apparent from figure C-18, for example.

2. K-FACTOR DEPENDENCE ON DOSE RESPONSE FUNCTIONS

The reduction or enhancement of the neutron dose in the real variable density atmosphere over the mass integral scaled dose depends not only on the source and detector altitudes as shown previously, but also on the dose response function used. For a source at 20 kilometers, it is shown in figure 5 that the neutron K-factors for the silicon and tissue doses and the total fluence are similar for sampling altitudes coaltitude with the source. At 40 kilometers, however, figure 5 shows that the neutron K-factors can be quite different, with the tissue dose K-factor being only half as large as the silicon K-factor, and the K-factor for fluence even smaller. These differences in the K-factors at high altitude are related to the fact that the response functions are different and the energy spectrum arriving at a detector in the real atmosphere can be quite different from the spectrum calculated in homogeneous air at the same areal density. From this example it is clear that the neutron real air effects depend strongly on the dose response function used to weight the neutron fluence.

While the secondary gamma K-factors are strong functions of source altitude and mass range from the source as shown in

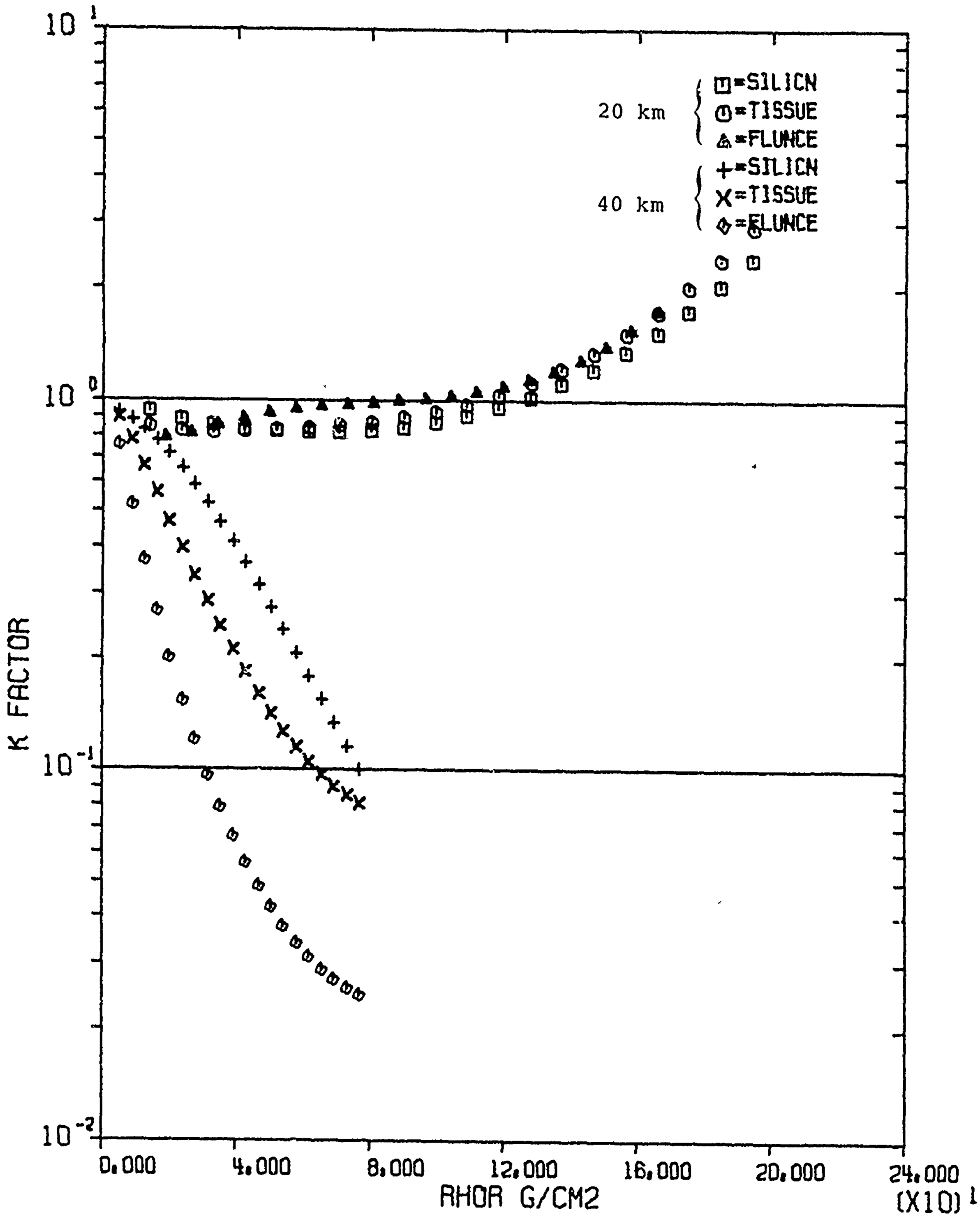

Figure 5. Silicon, Tissue, and Fluence Neutron K-factors Coaltitude from a 20 and 40 km Thermonuclear Source

figure 6, they are not so dependent on the response functions as was the case for neutrons.

3. K-FACTOR DEPENDENCE ON SOURCE SPECTRUM

In figure 7 the coaltitude neutron silicon dose K-factor is shown for both the thermonuclear and fission source spectra at source altitudes of 20 and 40 kilometers. At 20 kilometers, the differences between the two K-factors are small at all areal densities, despite the fact that the two initial emitted spectra are quite different. At 40 kilometers, however, the silicon dose K-factors for the thermonuclear source are much larger than the K-factors for the fission source at areal densities less than 70 gm/cm^2. At 40 gm/cm^2, for example, the coaltitude neutron silicon K-factor for a thermonuclear source spectrum is twice as large as the K-factor for a fission source. Similar results for the secondary gamma doses are shown in figure 8. At 60 gm/cm^2 the silicon K-factor for secondary gammas from a thermonuclear source is less than one-third of the silicon dose K-factor from a fission source spectrum coaltitude from a source at 40 kilometers. At 20 kilometers, however, the secondary gamma K-factors are nearly identical.

It is apparent from figures 7 and 8 that mass integral scaling can lead to very large errors in the neutron and secondary gamma environments in the atmosphere, and that the magnitude of these errors depends rather strongly on the source spectrum. In general, the K-factors for the fission source are less than those for a thermonuclear source indicating the scaling errors for this source spectrum are even greater than they are for a thermonuclear source.

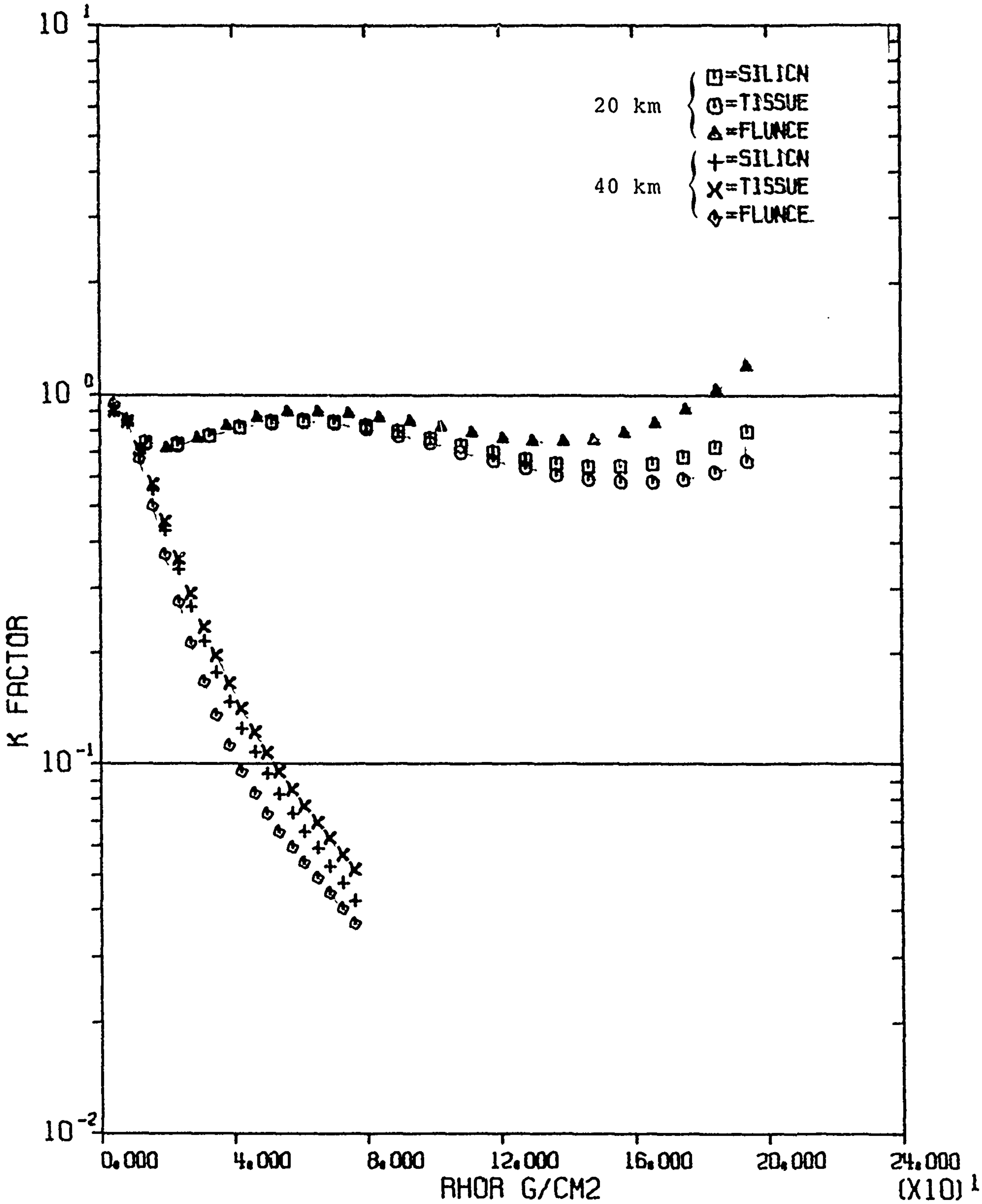

Figure 6. Silicon, Tissue, and Fluence Secondary Gamma K-factors Coaltitude from a 20 and 40 km Thermonuclear Source

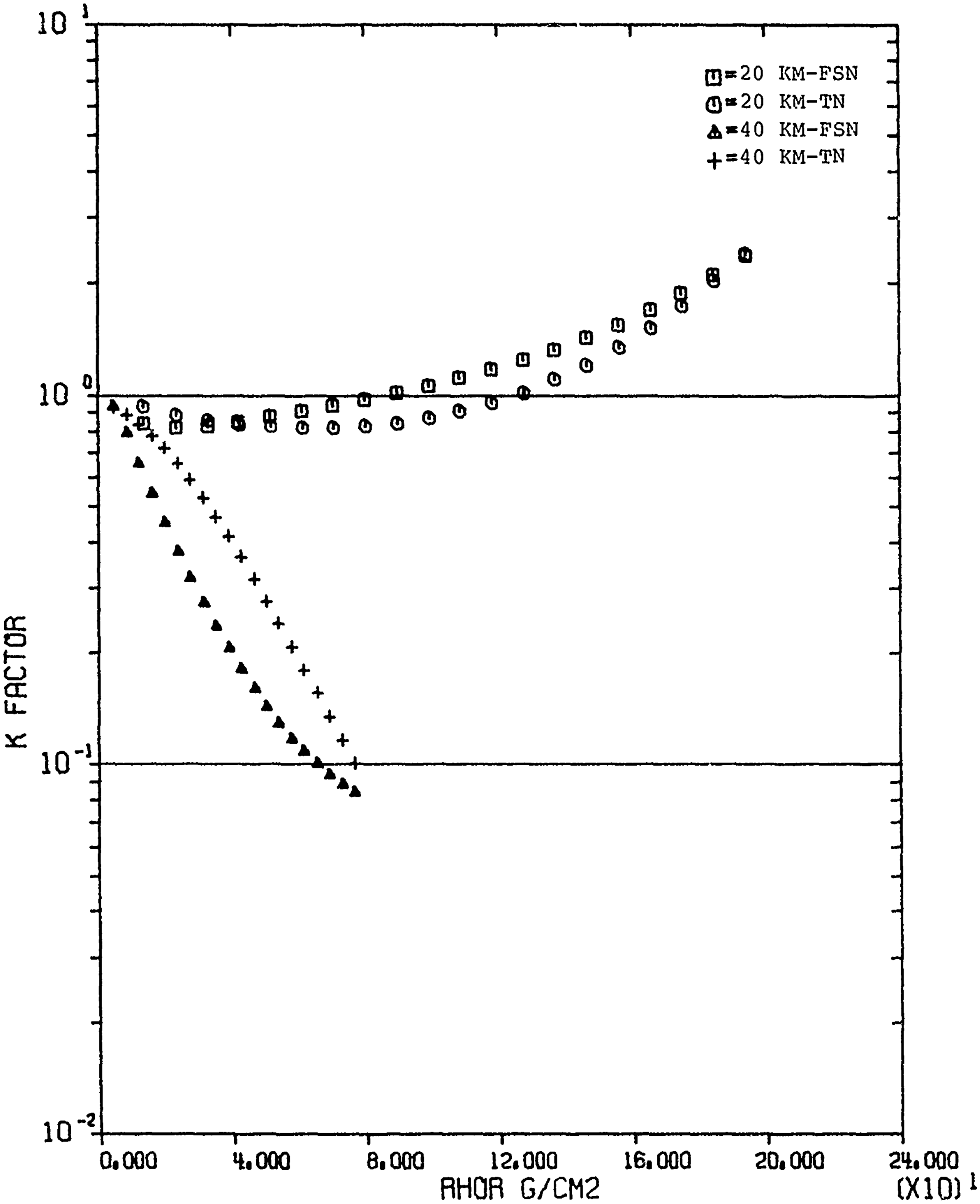

Figure 7. Coaltitude Neutron Silicon Dose K-factors at 20 and 40 km from both a Fission and Thermonuclear Source

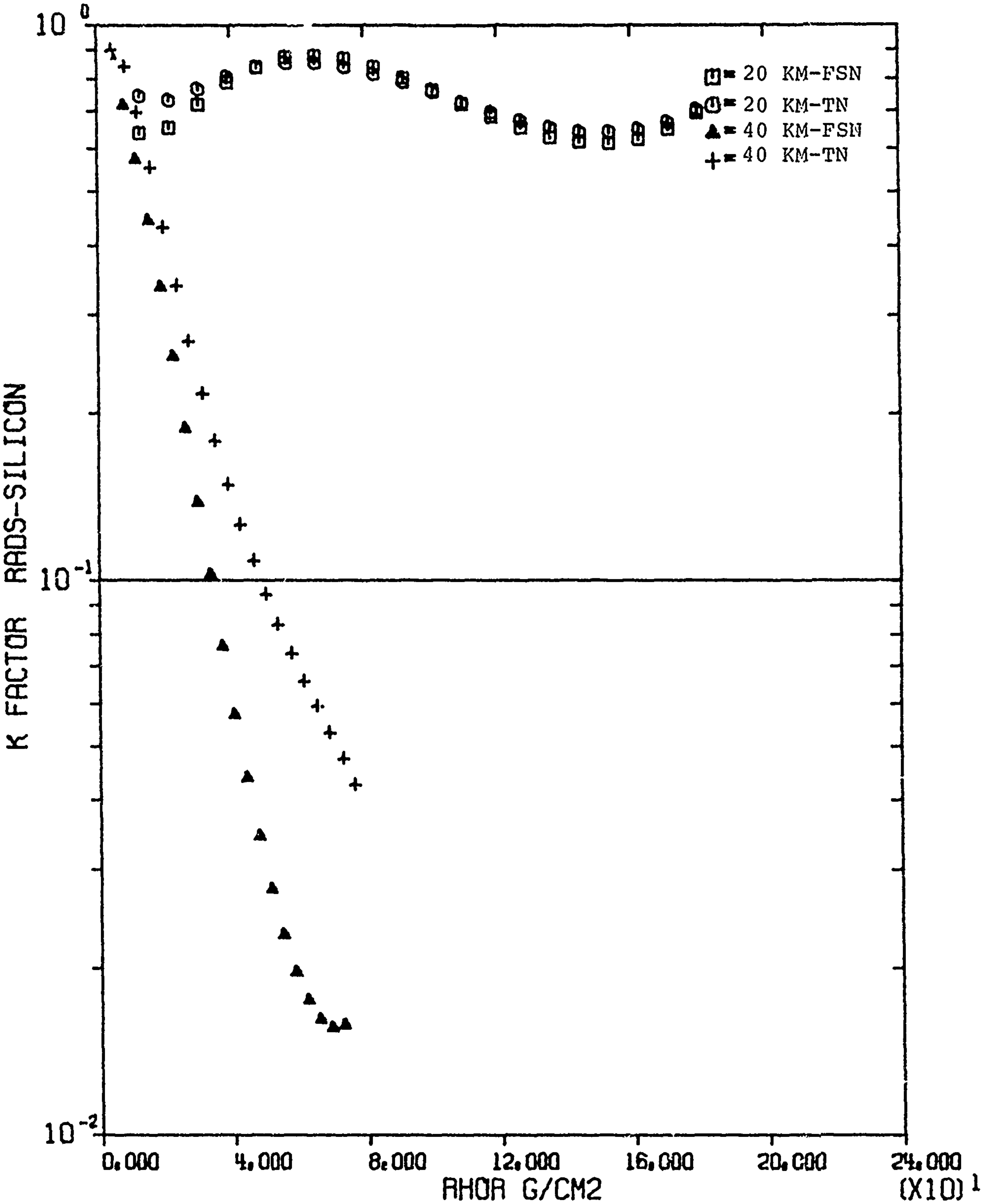

Figure 8. Coaltitude Secondary Gamma Silicon Dose K-factors at 20 and 40 km from both a Fission and Thermonuclear Source

4. SECONDARY GAMMA K-FACTORS AT SMALL MASS RANGES

There is one feature of the results for secondary gamma doses at the highest altitudes, 60 kilometers and above, that deserves an additional comment. Figure C-84 in Appendix C is a good example of this data for the case of a thermonuclear source at 80 kilometers. The silicon K-factors for the higher sampling altitudes are very large at low mass ranges. The K-factor, as was pointed out in section 3, is the ratio of the $4\pi R^2$ dose in real air to the $4\pi R^2$ dose in homogeneous air. The homogeneous results for this study were based on ANISN code calculations. Because of the uncertainties in these results at small mass ranges, most scaling codes use an interpolation method between 0.0 and about 1.0 gm/cm^2. Such a method was used to produce the homogeneous data shown in Appendix A. No such approximations or assumptions were necessary in the MORSAIR results. So it should be noted that while the K-factors at these small mass ranges may not necessarily reflect differences between the homogeneous and real air results, they do reflect differences between the real air results and those from typical scaling codes.

SECTION V
SUMMARY AND CONCLUSIONS

In this report we have presented the results of 15 MORSAIR Monte Carlo code calculations of neutron and secondary gamma transport in a real variable density atmosphere. The two source spectra used in these calculations were an unclassified fission spectrum and an unclassified thermonuclear spectrum. The source altitudes varied from 5 to 80 kilometers and the energy dependent particle fluences were scored at more than 150 detectors located about the source for each run. The spectrum at each detector was weighted with fluence, silicon, and tissue dose response functions. The $4\pi R^2$ dose data has been fit to a seven parameter equation in areal density at each sampling altitude of the MORSAIR run. Coefficients of these fits and plots of the silicon dose and K-factors have been presented. We have shown how the K-factor, the correction to the scaled homogeneous transport data to account for variable density atmosphere effects, depends on several parameters.

As stated at the outset, the objective of this study was to provide data which would lend some insight into the accuracy of mass integral scaling of homogeneous air transport data at high altitudes. The data presented in this report demonstrate that mass integral scaling can lead to large errors particularly for source altitudes greater than 20 kilometers. We believe these data can serve as the basis of an algorithm for predicting the correction to the mass integral scaled dose for sources and response functions similar to those used in this study.

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APPENDIX A

ANISN HOMOGENEOUS AIR DATA

This appendix contains the coefficients of the fits to the neutron and secondary gamma transport ANISN code results provided by AFWL (ref. 12). The data was fit to the equation

$$\ln (4\pi R^2 \text{ Dose}) = A + Bx + Cx^2 + Dx^{3/2} + Ex^{1/2} + Fx^{1/3} + G \ln x$$

where x is the mass range in gm/cm^2.

The coefficients of this fit for the different doses and sources are shown in Table 6.

The $4\pi R^2$ doses and fluences as calculated using these fits for both neutrons and secondary gammas have been plotted for the two source spectra in figures A-1 through A-6.

TABLE 6

ANISN HOMOGENEOUS AIR DATA

NEUTRONS

DOSE	SOURCE	A	B	C	D	E	F	G
SILICON	THERMONUCLEAR	-.20795E+02	-.97296E-01	-.17913E-04	.15771E-02	.17924E+01	-.32101E+01	.23746E+00
TISSUE	THERMONUCLEAR	-.19711E+02	-.98348E-01	-.22342E-04	.18226E-02	.13159E+01	-.15135E+01	-.84022E-02
FLUENCE	THERMONUCLEAR	-.67750E+01	.52690E-02	-.54364E-05	-.21468E-03	-.38214E+01	.10875E+02	-.13975E+01
SILICON	FISSION	-.21780E+02	-.16126E+00	-.46917E-04	.38861E-02	.27024E+01	-.41190E+01	.21249E+00
TISSUE	FISSION	-.18463E+02	-.17636E+00	-.53973E-04	.44464E-02	.28502E+01	-.40883E+01	.17644E+00
FLUENCE	FISSION	.79627E+00	-.22572E+00	-.73701E-04	.61127E-02	.33426E+01	-.37018E+01	-.30794E-01

SECONDARY GAMMAS

DOSE	SOURCE	A	B	C	D	E	F	G
SILICON	THERMONUCLEAR	-.25281E+02	-.90163E-01	-.27961E-04	.23939E-02	.95659E+00	-.11394E+01	.98116E+00
TISSUE	THERMONUCLEAR	-.25566E+02	-.79950E-01	-.24566E-04	.21001E-02	.65711E+00	-.57589E+00	.93271E+00
FLUENCE	THERMONUCLEAR	-.48600E+01	-.11511E+00	-.37267E-04	.31732E-02	.13350E+01	-.13011E+01	.95495E+00
SILICON	FISSION	-.26416E+02	-.16697E+00	-.56993E-04	.48224E-02	.25366E+01	-.35154E+01	.10916E+01
TISSUE	FISSION	-.26313E+02	-.16462E+00	-.55756E-04	.47309E-02	.25300E+01	-.36007E+01	.11093E+01
FLUENCE	FISSION	-.57438E+01	-.16896E+00	-.55243E-04	.47643E-02	.25725E+01	-.33967E+01	.11089E+01

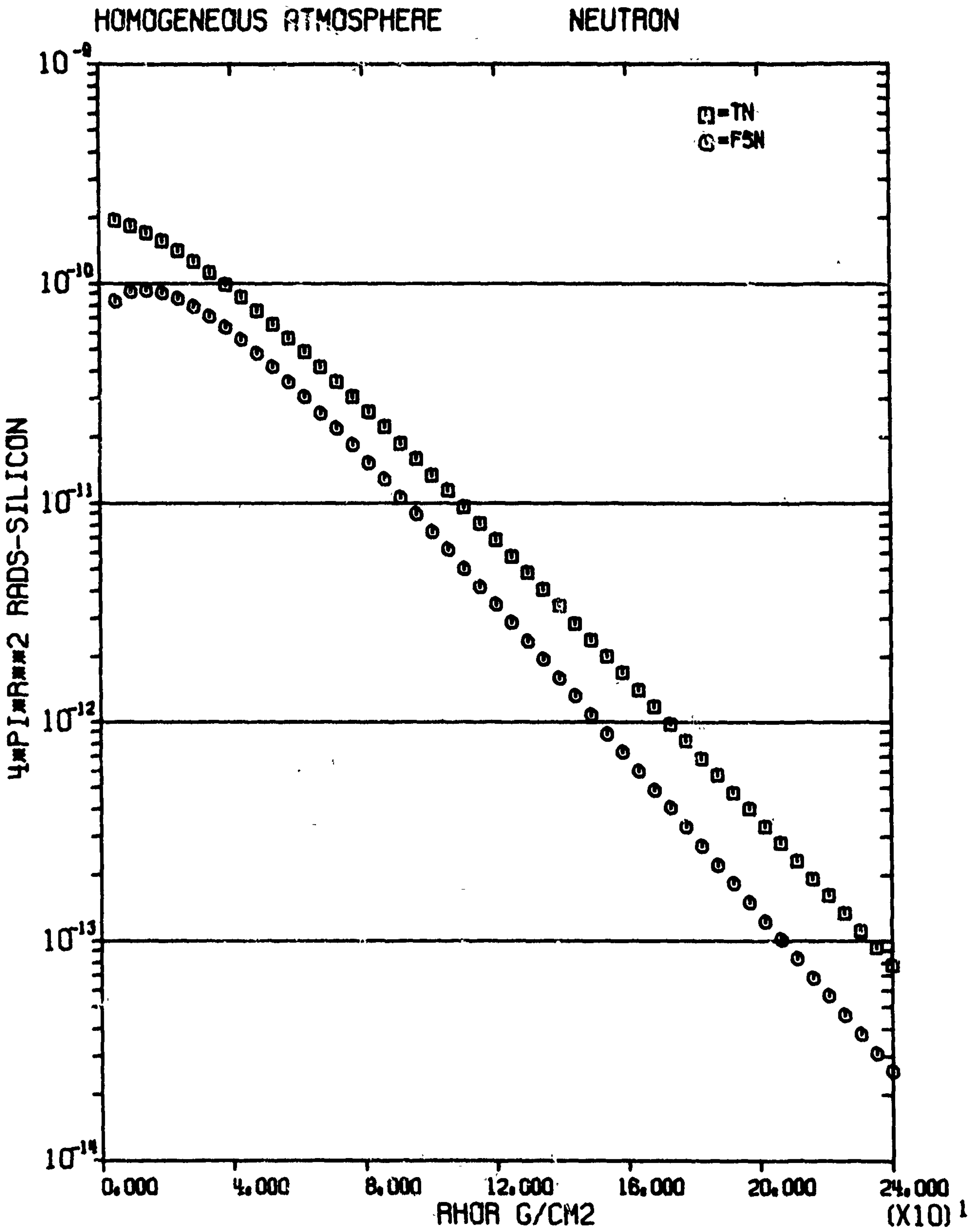


Figure A-1. Homogeneous ANISN Fit Data. $4\pi R^2$ Neutron Silicon Dose for a Fission and Thermonuclear Source.

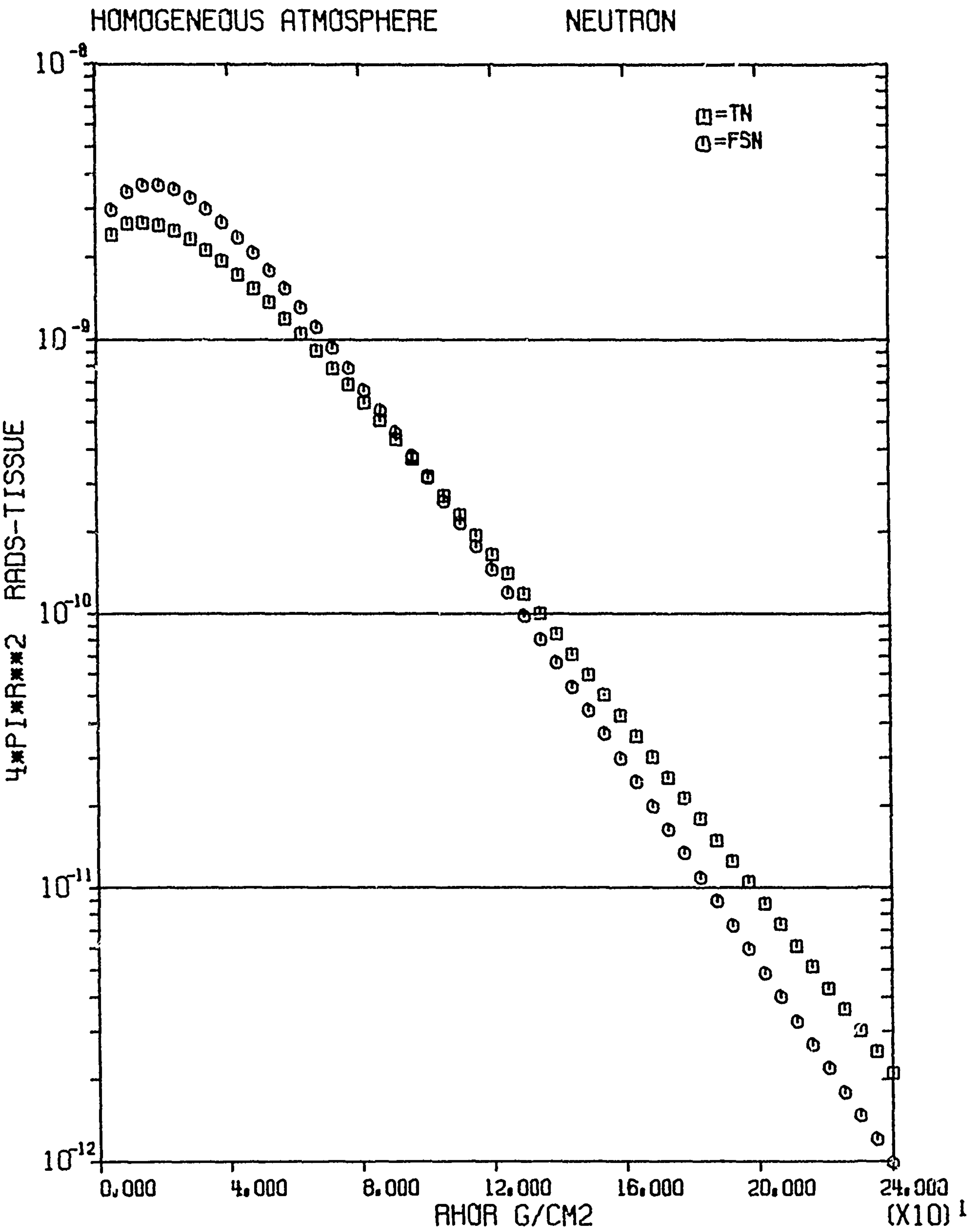


Figure A-2. Homogeneous ANISN Fit Data. $4\pi R^2$ Neutron Tissue Dose for a Fission and Thermonuclear Source.

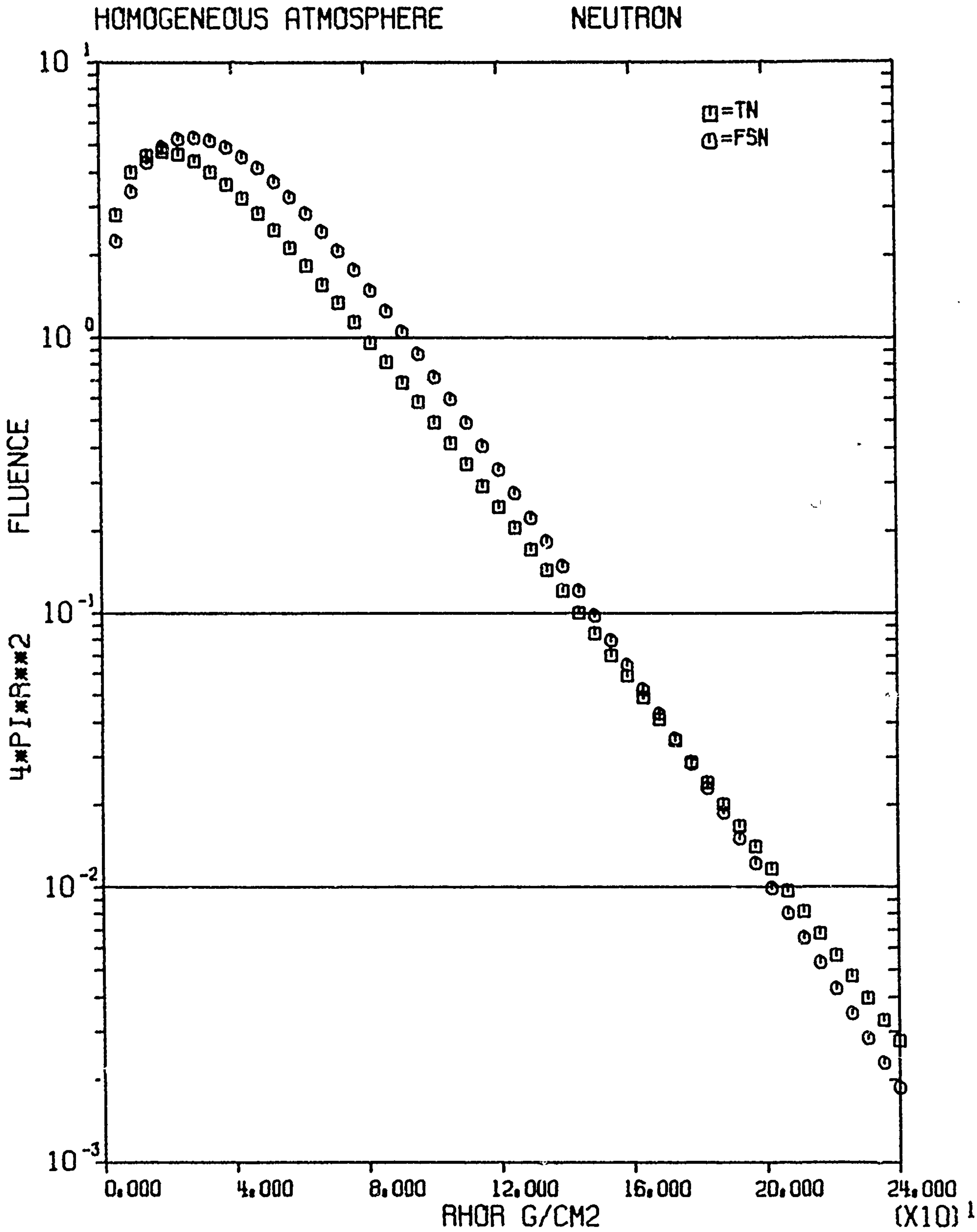


Figure A-3. Homogeneous ANISN Fit Data. $4\pi R^2$ Neutron Fluence for a Fission and Thermonuclear Source.

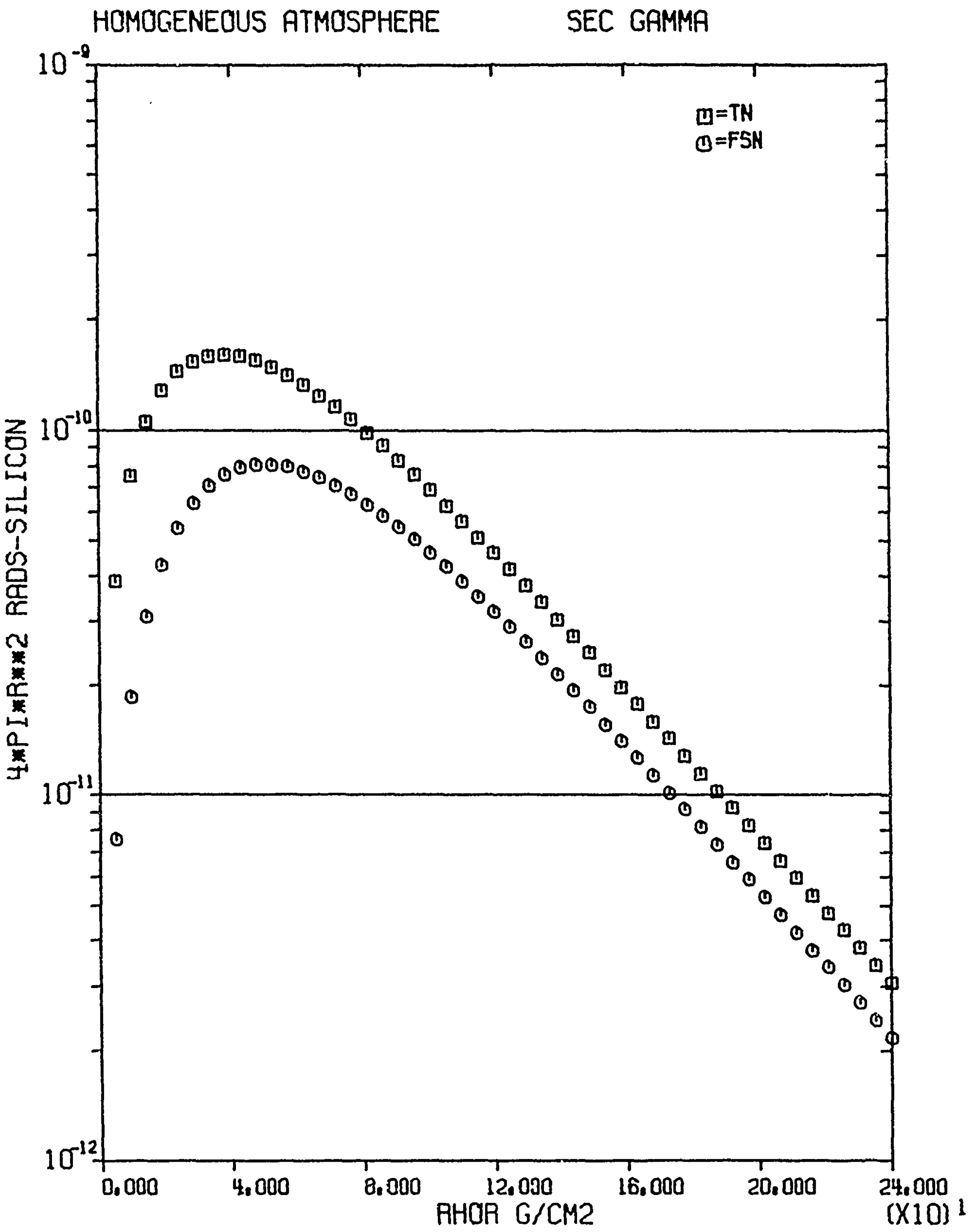


Figure A-4. Homogeneous ANISN Fit Data. $4\pi R^2$ Secondary Gamma Silicon Dose for a Fission and Thermonuclear Source.

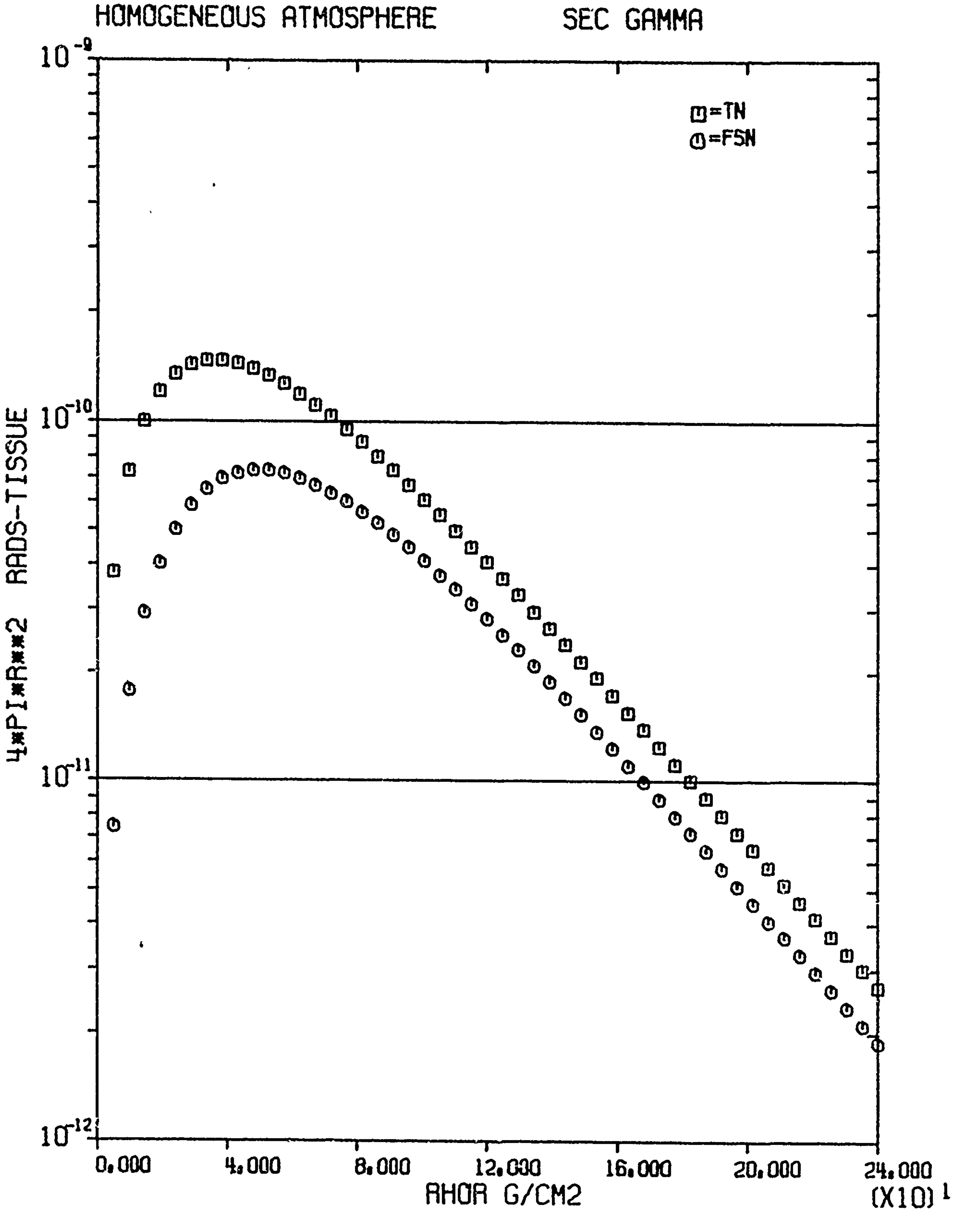


Figure A-5. Homogeneous ANISN Fit Data. $4\pi R^2$ Secondary Gamma Tissue Dose for a Fission and Thermonuclear Source.

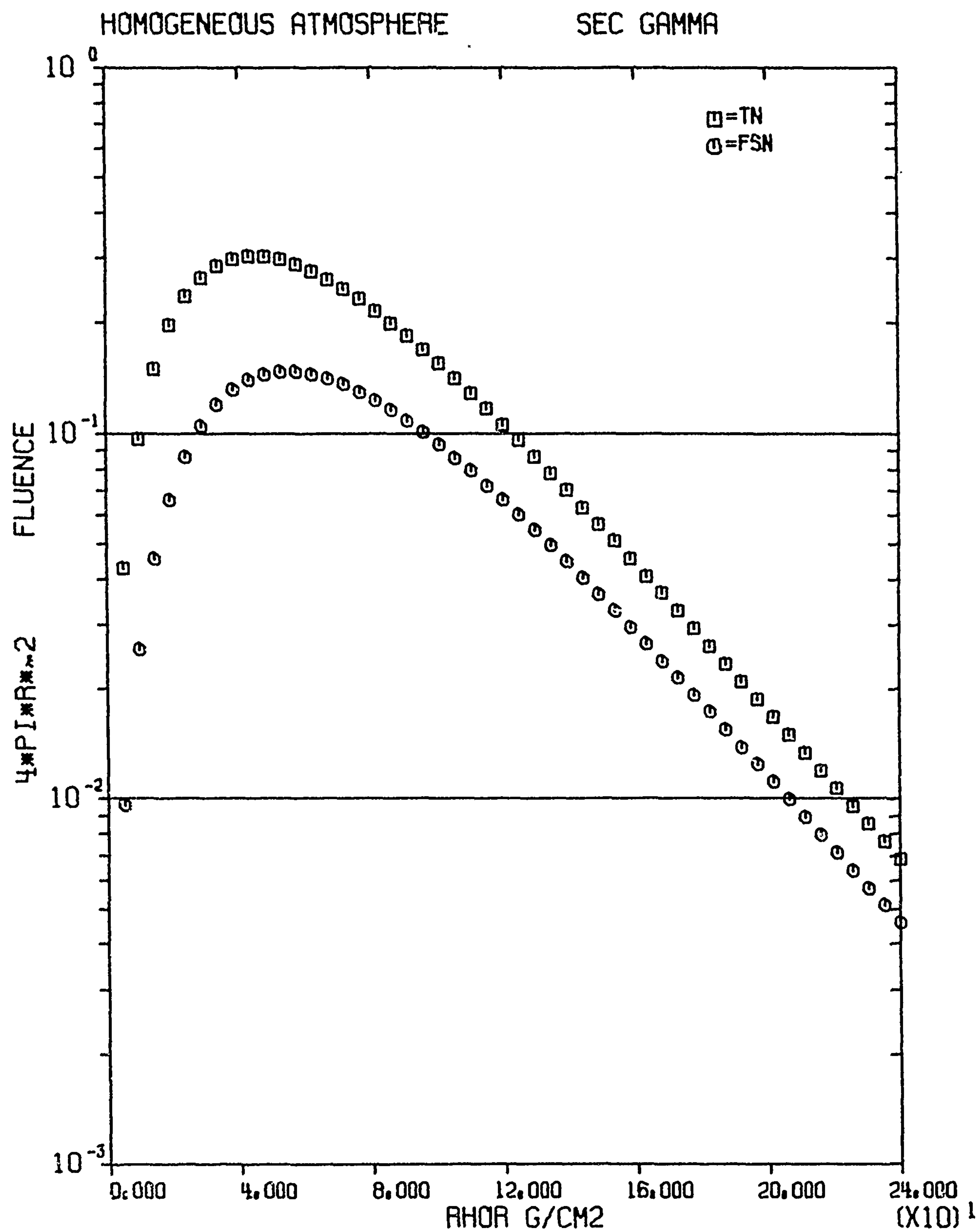


Figure A-6. Homogeneous ANISN Fit Data. $4\pi R^2$ Secondary Gamma Fluence for a Fission and Thermonuclear Source.

APPENDIX B
FITS OF MORSAIR REAL AIR DATA

This appendix contains the results of a weighted least squares fit to the MORSAIR data. For each of the 15 MORSAIR runs, the following data is given at each sampling altitude:

1. The sampling altitude in kilometers.
2. The dose response function.
3. The minimum and maximum mass ranges at which the fit is considered valid.
4. The coefficients to the fit equation:

$$\ln (4\pi R^2 \text{ Dose}) = A + Bx + Cx^2 + Dx^{3/2} + Ex^{1/2} + Fx^{1/3} + G \ln x$$

where x is the mass range in gm/cm^2

5. The root mean square percentage difference between the fit values and the actual MORSAIR data.

These data are shown for both the neutron and secondary gammas.

TABLE 7

FIT COEFFICIENTS FOR MORSAIR RUN NO. 1
FISSION SOURCE IN A HOMOGENEOUS ATMOSPHERE

NEUTRONS

SAMPLING ALTITUDE (KM)	DOSE	MIN RHOR GM/CM2	MAX RHOR GM/CM2	FIT COEFFICIENTS A	B	C	D	E	F	G	RMS PCT DIFF
3.11	SILICON	101.600	192.600	-.21409E+02	-.41939E-01	0.	0.	0.	0.	0.	.681
3.11	TISSUE	101.600	192.600	-.17826E+02	-.40524E-01	0.	0.	0.	0.	0.	.700
3.11	FLUENCE	101.600	192.600	.35968E+01	-.39339E-01	0.	0.	0.	0.	0.	
3.83	SILICON	21.800	180.000	-.22411E+02	-.38146E-01	-.19525E-03	.26914E-02	0.	0.	0.	.325
3.83	TISSUE	21.800	180.000	-.19000E+02	-.59769E-02	.14506E-04	-.23253E-02	0.	0.	0.	.325
3.83	FLUENCE	21.800	180.000	.13396E+01	.59657E-01	.32705E-03	-.10883E-01	0.	0.	0.	
4.01	SILICON	3.647	192.300	-.23513E+02	.33049E-01	.33258E-03	-.96391E-02	.88920E-01	0.	0.	.147
4.01	TISSUE	3.647	200.000	-.20111E+02	.25827E-01	.35142E-03	-.97376E-02	.18887E+00	0.	0.	.209
4.01	FLUENCE	6.209	200.000	-.22379E+00	.37544E-01	.51785E-03	-.13594E-01	.45773E+00	0.	0.	
4.92	SILICON	101.600	200.000	-.21822E+02	-.39103E-01	0.	0.	0.	0.	0.	.951
4.92	TISSUE	101.600	200.000	-.17816E+02	-.40904E-01	0.	0.	0.	0.	0.	.894
4.92	FLUENCE	101.600	200.000	.40894E+01	-.43433E-01	0.	0.	0.	0.	0.	

SECONDARY GAMMAS

SAMPLING ALTITUDE (KM)	DOSE	MIN RHOR GM/CM2	MAX RHOR GM/CM2	FIT COEFFICIENTS A	B	C	D	E	F	G	RMS PCT DIFF
3.11	SILICON	101.600	192.600	-.21606E+02	-.21348E-01	0.	0.	0.	0.	0.	.312
3.11	TISSUE	101.600	192.600	-.21733E+02	-.21345E-01	0.	0.	0.	0.	0.	.309
3.11	FLUENCE	101.600	192.600	-.12296E+00	-.21479E-01	0.	0.	0.	0.	0.	
3.83	SILICON	21.800	192.900	-.25228E+02	.14821E+00	.63142E-03	-.19673E-01	0.	0.	0.	.305
3.83	TISSUE	21.800	192.900	-.25266E+02	.14653E+00	.63228E-03	-.19594E-01	0.	0.	0.	.309
3.83	FLUENCE	24.380	192.900	-.40782E+01	.14559E+00	.56770E-03	-.18522E-01	0.	0.	0.	
4.01	SILICON	.091	200.000	-.38242E+02	.46736E+00	.65214E-03	-.27368E-01	-.10136E+02	.19383E+02	0.	.291
4.01	TISSUE	.091	200.000	-.38295E+02	.46236E+00	.64246E-03	-.27023E-01	-.10079E+02	.19278E+02	0.	.308
4.01	FLUENCE	.091	200.000	-.17445E+02	.43522E+00	.55878E-03	-.24526E-01	-.98774E+01	.19240E+02	0.	
4.92	SILICON	101.600	200.000	-.21602E+02	-.22049E-01	0.	0.	0.	0.	0.	.387
4.92	TISSUE	101.600	200.000	-.21689E+02	-.22352E-01	0.	0.	0.	0.	0.	.386
4.92	FLUENCE	101.600	200.000	-.22481E+00	-.21530E-01	0.	0.	0.	0.	0.	

TABLE 8

FIT COEFFICIENTS FOR MORSAIR RUN NO. 2
FISSION SOURCE IN REAL AIR AT 5.0 km

NEUTRONS

SAMPLING ALTITUDE (KM)	DOSE	MIN RHOR GM/CM2	MAX RHOR GM/CM2	FIT COEFFICIENTS A	B	C	D	E	F	G	RMS PCT DIFF
3.68	SILICON	106.500	193.800	-.21214E+02	-.43167E-01	0.	0.	0.	0.	0.	.688
3.68	TISSUE	106.500	193.800	-.17641E+02	-.41738E-01	0.	0.	0.	0.	0.	.657
3.68	FLUENCE	106.500	193.800	.41278E+01	-.43930E-01	0.	0.	0.	0.	0.	
4.40	SILICON	47.000	193.900	-.21933E+02	-.32688E-01	.19830E-04	-.69318E-03	0.	0.	0.	.331
4.40	TISSUE	47.000	193.900	-.18622E+02	-.44465E-02	.15472E-03	-.43986E-02	0.	0.	0.	.339
4.40	FLUENCE	47.000	193.900	.15182E+01	.71357E-01	.49597E-03	-.13919E-01	0.	0.	0.	
5.07	SILICON	6.637	194.100	-.23316E+02	.47701E-01	.36934E-03	-.10774E-01	0.	0.	0.	.152
5.07	TISSUE	6.637	194.100	-.19752E+02	.60053E-01	.43203E-03	-.12405E-01	0.	0.	0.	.213
5.07	FLUENCE	10.160	194.100	.62790E+00	.11563E+00	.62790E-03	-.18764E-01	0.	0.	0.	
5.91	SILICON	66.020	190.700	-.21358E+02	-.44484E-01	.22751E-04	0.	0.	0.	0.	.383
5.91	TISSUE	66.020	197.800	-.17759E+02	-.41919E-01	.12823E-04	0.	0.	0.	0.	.355
5.91	FLUENCE	66.020	197.800	.31074E+01	-.30242E-01	-.36078E-04	0.	0.	0.	0.	

SECONDARY GAMMAS

SAMPLING ALTITUDE (KM)	DOSE	MIN RHOR GM/CM2	MAX RHOR GM/CM2	FIT COEFFICIENTS A	B	C	D	E	F	G	RMS PCT DIFF
3.68	SILICON	106.500	193.800	-.21853E+02	-.20954E-01	0.	0.	0.	0.	0.	.482
3.68	TISSUE	106.500	193.800	-.21970E+02	-.21113E-01	0.	0.	0.	0.	0.	.494
3.68	FLUENCE	106.500	193.800	-.31667E+00	-.20579E-01	0.	0.	0.	0.	0.	
4.40	SILICON	47.000	193.900	-.24685E+02	.11210E+00	.45154E-03	-.14861E-01	0.	0.	0.	.314
4.40	TISSUE	47.000	193.900	-.24764E+02	.11233E+00	.46717E-03	-.15107E-01	0.	0.	0.	.307
4.40	FLUENCE	47.000	193.900	-.31933E+01	.92462E-01	.34191E-03	-.11844E-01	0.	0.	0.	
5.07	SILICON	6.637	194.100	-.25873E+02	.19765E+00	.86527E-03	-.26239E-01	0.	0.	0.	.423
5.07	TISSUE	6.637	194.100	-.25891E+02	.19419E+00	.85384E-03	-.25878E-01	0.	0.	0.	.419
5.07	FLUENCE	10.160	194.100	-.49021E+01	.20891E+00	.89396E-03	-.27206E-01	0.	0.	0.	
5.91	SILICON	66.020	197.800	-.22037E+02	-.13451E-01	-.28775E-04	0.	0.	0.	0.	.283
5.91	TISSUE	66.020	197.800	-.22074E+02	-.14542E-01	-.25937E-04	0.	0.	0.	0.	.320
5.91	FLUENCE	66.020	197.800	-.88356E+00	-.12186E-01	-.23932E-04	0.	0.	0.	0.	

TABLE 9

FIT COEFFICIENTS FOR MORSAIR RUN NO. 3
FISSION SOURCE IN REAL AIR AT 10 km

NEUTRONS

SAMPLING ALTITUDE (KM)	DOSE	MIN RHOR GM/CM2	MAX RHOR GM/CM2	FIT COEFFICIENTS A	B	C	D	E	F	G	RMS PCT DIFF
7.95	SILICON	98.210	194.200	-.20591E+02	-.53372E-01	.43441E-04	0.	0.	0.	0.	.699
7.95	TISSUE	98.210	194.200	-.16496E+02	-.58127E-01	.57461E-04	0.	0.	0.	0.	.702
7.95	FLUENCE	98.210	194.200	.44926E+01	-.50621E-01	.40175E-04	0.	0.	0.	0.	
8.84	SILICON	53.250	189.200	-.21491E+02	-.45330E-01	.32852E-04	0.	0.	0.	0.	.506
8.84	TISSUE	53.250	197.200	-.17849E+02	-.42640E-01	.20277E-04	0.	0.	0.	0.	.494
8.84	FLUENCE	57.250	197.200	.30716E+01	-.31308E-01	-.25271E-04	0.	0.	0.	0.	
10.00	SILICON	2.288	194.700	-.23325E+02	.37691E-01	.24591E-03	-.85409E-02	0.	0.	0.	.278
10.00	TISSUE	2.288	194.700	-.19886E+02	.56246E-01	.27101E-03	-.10222E-01	0.	0.	0.	.343
10.00	FLUENCE	6.376	194.700	.38878E+00	.12716E+00	.64582E-03	-.19852E-01	0.	0.	0.	
12.13	SILICON	78.190	178.200	-.22233E+02	-.29301E-01	-.47391E-04	0.	0.	0.	0.	.299
12.13	TISSUE	78.190	186.200	-.18146E+02	-.34551E-01	-.25802E-04	0.	0.	0.	0.	.296
12.13	FLUENCE	78.190	186.200	.35637E+01	-.37875E-01	-.32529E-05	0.	0.	0.	0.	

SECONDARY GAMMAS

SAMPLING ALTITUDE (KM)	DOSE	MIN RHOR GM/CM2	MAX RHOR GM/CM2	FIT COEFFICIENTS A	B	C	D	E	F	G	RMS PCT DIFF
7.95	SILICON	98.210	194.200	-.22265E+02	-.16039E-01	-.16085E-04	0.	0.	0.	0.	.194
7.95	TISSUE	98.210	194.200	-.22397E+02	-.16017E-01	-.17352E-04	0.	0.	0.	0.	.234
7.95	FLUENCE	98.210	194.200	-.58645E+00	-.17155E-01	-.11927E-04	0.	0.	0.	0.	
8.84	SILICON	53.250	197.200	-.22683E+02	-.78809E-02	-.51383E-04	0.	0.	0.	0.	.362
8.84	TISSUE	53.250	197.200	-.22768E+02	-.84583E-02	-.50171E-04	0.	0.	0.	0.	.349
8.84	FLUENCE	57.250	197.200	-.14109E+01	-.51612E-02	-.54544E-04	0.	0.	0.	0.	
10.00	SILICON	2.288	194.700	-.26343E+02	.23296E+00	.10726E-02	-.31526E-01	0.	0.	0.	.558
10.00	TISSUE	2.288	194.700	-.26349E+02	.22918E+00	.10650E-02	-.31200E-01	0.	0.	0.	.543
10.00	FLUENCE	6.376	194.700	-.53970E+01	.24402E+00	.10479E-02	-.31831E-01	0.	0.	0.	
12.13	SILICON	78.190	194.200	-.21544E+02	-.22664E-01	.14136E-05	0.	0.	0.	0.	.313
12.13	TISSUE	[illegible].190	194.200	-.21606E+02	-.23598E-01	.48572E-05	0.	0.	0.	0.	.310
12.13	FLUENCE	[illegible] 190	194.200	-.30881E+00	-.21298E-01	.53339E-05	0.	0.	0.	0.	

TABLE 10

FIT COEFFICIENTS FOR MORSAIR RUN NO. 4
FISSION SOURCE IN REAL AIR AT 15 km

NEUTRONS

SAMPLING ALTITUDE (KM)	DOSE	MIN RHOR GM/CM2	MAX RHOR GM/CM2	FIT COEFFICIENTS A	B	C	D	E	F	G	RMS PCT DIFF
11.30	SILICON	105.100	195.600	-.22760E+02	-.32504E-01	0.	0.	0.	0.	0.	.973
11.30	TISSUE	105.100	195.600	-.18534E+02	-.35766E-01	0.	0.	0.	0.	0.	.779
11.30	FLUENCE	105.100	195.600	.35957E+01	-.39578E-01	0.	0.	0.	0.	0.	
12.80	SILICON	58.450	194.900	-.22720E+02	-.22854E-01	-.69490E-04	0.	0.	0.	0.	.387
12.80	TISSUE	58.450	194.900	-.18771E+02	-.26164E-01	-.53894E-04	0.	0.	0.	0.	.400
12.80	FLUENCE	58.450	187.100	.32300E+01	-.34443E-01	-.68838E-05	0.	0.	0.	0.	
15.29	SILICON	3.793	198.000	-.23283E+02	.29445E-01	.22939E-03	-.75145E-02	0.	0.	0.	.346
15.29	TISSUE	3.793	198.000	-.19785E+02	.53002E-01	.39036E-03	-.11229E-01	0.	0.	0.	.412
15.29	FLUENCE	9.650	190.300	.52993E+00	.11990E+00	.63646E-03	-.19134E-01	0.	0.	0.	
17.37	SILICON	35.050	186.900	-.22994E+02	.96069E-02	.11903E-03	-.46892E-02	0.	0.	0.	.314
17.37	TISSUE	35.050	194.700	-.19110E+02	.71814E-03	.87352E-04	-.36281E-02	0.	0.	0.	.254
17.37	FLUENCE	35.050	194.700	.17189E+01	.34928E-01	.22723E-03	-.76602E-02	0.	0.	0.	
21.66	SILICON	76.900	195.700	-.21504E+02	-.46112E-01	.45332E-04	0.	0.	0.	0.	.549
21.66	TISSUE	76.900	195.700	-.17895E+02	-.44370E-01	.40961E-04	0.	0.	0.	0.	.520
21.66	FLUENCE	76.900	195.700	.32591E+01	-.39833E-01	.37641E-04	0.	0.	0.	0.	
25.51	SILICON	96.960	195.000	-.23316E+02	-.19635E-01	-.50051E-04	0.	0.	0.	0.	.698
25.51	TISSUE	96.960	195.000	-.18902E+02	-.30692E-01	-.62825E-05	0.	0.	0.	0.	.738
25.51	FLUENCE	96.960	195.000	.31513E+01	-.42369E-01	.50287E-04	0.	0.	0.	0.	

SECONDARY GAMMAS

SAMPLING ALTITUDE (KM)	DOSE	MIN RHOR GM/CM2	MAX RHOR GM/CM2	FIT COEFFICIENTS A	B	C	D	E	F	G	RMS PCT DIFF
11.30	SILICON	105.100	195.600	-.22019E+02	-.21256E-01	0.	0.	0.	0.	0.	.295
11.30	TISSUE	105.100	195.600	-.22166E+02	-.21397E-01	0.	0.	0.	0.	0.	.354
11.30	FLUENCE	105.100	195.600	-.48282E+00	-.20006E-01	0.	0.	0.	0.	0.	
12.80	SILICON	58.450	194.900	-.22267E+02	-.17650E-01	-.12069E-04	0.	0.	0.	0.	.450
12.80	TISSUE	58.450	194.900	-.22346E+02	-.18271E-01	-.11770E-04	0.	0.	0.	0.	.461
12.80	FLUENCE	58.450	194.900	-.13552E+01	-.82566E-02	-.36536E-04	0.	0.	0.	0.	
15.29	SILICON	3.793	198.000	-.26104E+02	.20949E+00	.94880E-03	-.28264E-01	0.	0.	0.	.684
15.29	TISSUE	3.793	198.000	-.26084E+02	.20060E+00	.89618E-03	-.27013E-01	0.	0.	0.	.708
15.29	FLUENCE	9.650	198.000	-.52489E+01	.22972E+00	.10133E-02	-.30275E-01	0.	0.	0.	
17.37	SILICON	35.050	194.700	-.24667E+02	.10860E+00	.43394E-03	-.14380E-01	0.	0.	0.	.225
17.37	TISSUE	35.050	194.700	-.24716E+02	.10592E+00	.42035E-03	-.14049E-01	0.	0.	0.	.235
17.37	FLUENCE	35.050	194.700	-.36914E+01	.11868E+00	.46428E-03	-.15219E-01	0.	0.	0.	
21.66	SILICON	76.900	195.700	-.21460E+02	-.27679E-01	.31248E-04	0.	0.	0.	0.	.532
21.66	TISSUE	76.900	195.700	-.21381E+02	-.30976E-01	.44346E-04	0.	0.	0.	0.	.562
21.66	FLUENCE	76.900	195.700	-.64818E+00	-.19059E-01	.42684E-05	0.	0.	0.	0.	
25.51	SILICON	96.960	195.000	-.22343E+02	-.18025E-01	.10080E-04	0.	0.	0.	0.	.345
25.51	TISSUE	96.960	195.000	-.22341E+02	-.19541E-01	.14874E-04	0.	0.	0.	0.	.367
25.51	FLUENCE	96.960	195.000	-.12412E+01	-.13446E-01	-.81247E-05	0.	0.	0.	0.	

TABLE 11

FIT COEFFICIENTS FOR MORSAIR RUN NO. 5
FISSION SOURCE IN REAL AIR AT 20 km

NEUTRONS

SAMPLING ALTITUDE (KM)	DOSE	MIN RHOR GM/CM2	MAX RHOR GM/CM2	FIT COEFFICIENTS A	B	C	D	E	F	G	RMS PCT DIFF
12.10	SILICON	146.500	195.400	-.22335E+02	-.35872E-01	0.	0.	0.	0.	0.	2.151
12.10	TISSUE	146.500	195.400	-.17028E+02	-.44564E-01	0.	0.	0.	0.	0.	2.288
12.10	FLUENCE	146.500	195.400	.20633E+01	-.31650E-01	0.	0.	0.	0.	0.	
14.85	SILICON	77.770	200.000	-.22626E+02	-.29758E-01	-.17442E-04	0.	0.	0.	0.	.617
14.85	TISSUE	77.770	185.700	-.18610E+02	-.32143E-01	-.13448E-04	0.	0.	0.	0.	.491
14.85	FLUENCE	77.770	185.700	.31189E+01	-.35988E-01	.86560E-05	0.	0.	0.	0.	
20.61	SILICON	4.149	193.900	-.23339E+02	.31543E-01	.29646E-03	-.83187E-02	0.	0.	0.	.224
20.61	TISSUE	4.149	193.900	-.19776E+02	.41472E-01	.32934E-03	-.93537E-02	0.	0.	0.	.364
20.61	FLUENCE	10.690	193.900	.48472E+00	.11808E+00	.72571E-03	-.19665E-01	0.	0.	0.	
22.08	SILICON	13.370	180.000	-.23020E+02	.12286E-01	.24718E-03	-.62228E-02	0.	0.	0.	.312
22.08	TISSUE	13.370	180.000	-.19383E+02	.17341E-01	.26595E-03	-.67195E-02	0.	0.	0.	.366
22.08	FLUENCE	19.220	180.000	.11283E+01	.69653E-01	.49685E-03	-.13146E-01	0.	0.	0.	
26.13	SILICON	32.110	197.500	-.22202E+02	-.32571E-01	.14199E-03	-.16530E-02	0.	0.	0.	.239
26.13	TISSUE	32.110	197.500	-.18344E+02	-.50332E-01	.40365E-05	.14918E-02	0.	0.	0.	.229
26.13	FLUENCE	32.110	197.500	.22669E+01	-.94284E-02	.18282E-03	-.33789E-02	0.	0.	0.	
34.72	SILICON	47.910	196.800	-.21063E+02	-.94457E-01	-.75136E-04	.52512E-02	0.	0.	0.	.416
34.72	TISSUE	47.910	196.800	-.17345E+02	-.10540E+00	-.17273E-03	.74060E-02	0.	0.	0.	.347
34.72	FLUENCE	47.910	196.800	.36959E+01	-.11109E+00	-.24472E-03	.90739E-02	0.	0.	0.	

SECONDARY GAMMAS

SAMPLING ALTITUDE (KM)	DOSE	MIN RHOR GM/CM2	MAX RHOR GM/CM2	FIT COEFFICIENTS A	B	C	D	E	F	G	RMS PCT DIFF
12.10	SILICON	146.500	195.400	-.21067E+02	-.29594E-01	0.	0.	0.	0.	0.	.388
12.10	TISSUE	146.500	195.400	-.21659E+02	-.27217E-01	0.	0.	0.	0.	0.	.376
12.10	FLUENCE	146.500	195.400	.92595E+00	-.30961E-01	0.	0.	0.	0.	0.	
14.85	SILICON	77.770	200.000	-.22597E+02	-.13759E-01	-.24796E-04	0.	0.	0.	0.	.357
14.85	TISSUE	77.770	200.000	-.22655E+02	-.15233E-01	-.20135E-04	0.	0.	0.	0.	.358
14.85	FLUENCE	77.770	200.000	-.11193E+01	-.11174E-01	-.27604E-04	0.	0.	0.	0.	
20.61	SILICON	4.149	193.900	-.26428E+02	.22272E+00	.10354E-02	-.30242E-01	0.	0.	0.	.561
20.61	TISSUE	4.149	193.900	-.26436E+02	.21781E+00	.10112E-02	-.29642E-01	0.	0.	0.	.560
20.61	FLUENCE	10.690	193.900	-.54619E+01	.23965E+00	.11275E-02	-.32353E-01	0.	0.	0.	
22.08	SILICON	13.370	195.400	-.25671E+02	.16984E+00	.82754E-03	-.23641E-01	0.	0.	0.	.398
22.08	TISSUE	13.370	195.400	-.25705E+02	.16749E+00	.82225E-03	-.23440E-01	0.	0.	0.	.402
22.08	FLUENCE	19.220	195.400	-.46048E+01	.17462E+00	.80759E-03	-.23537E-01	0.	0.	0.	
26.13	SILICON	32.110	197.500	-.24075E+02	.55748E-01	.23942E-03	-.79982E-02	0.	0.	0.	.255
26.13	TISSUE	32.110	197.500	-.24086E+02	.51479E-01	.21777E-03	-.74484E-02	0.	0.	0.	.267
26.13	FLUENCE	32.110	197.500	-.33905E+01	.91537E-01	.41287E-03	-.12665E-01	0.	0.	0.	
34.72	SILICON	47.910	196.800	-.23002E+02	-.13687E-01	-.10206E-03	.11284E-02	0.	0.	0.	.207
34.72	TISSUE	47.910	196.800	-.23031E+02	-.17037E-01	-.12262E-03	.16304E-02	0.	0.	0.	.214
34.72	FLUENCE	47.910	196.800	-.14404E+01	-.27887E-01	-.10426E-03	.21684E-02	0.	0.	0.	

TABLE 12

FIT COEFFICIENTS FOR MORSAIR RUN NO. 6
FISSION SOURCE IN REAL AIR AT 30 km

NEUTRONS

SAMPLING ALTITUDE (KM)	DOSE	MIN RHOR GM/CM2	MAX RHOR GM/CM2	FIT COEFFICIENTS A	B	C	D	E	F	G	RMS PCT DIFF
15.00	SILICON	114.200	192.500	-.21952E+02	-.39714E-01	0.	0.	0.	0.	0.	1.015
15.00	TISSUE	114.200	192.500	-.18446E+02	-.37586E-01	0.	0.	0.	0.	0.	1.036
15.00	FLUENCE	114.200	192.500	.23583E+01	-.31269E-01	0.	0.	0.	0.	0.	
20.00	SILICON	46.240	180.000	-.22255E+02	-.58453E-01	-.94535E-04	.33264E-02	0.	0.	0.	.306
20.00	TISSUE	46.240	180.000	-.18067E+02	-.83583E-01	-.19575E-03	.64447E-02	0.	0.	0.	.253
20.00	FLUENCE	46.240	180.000	.29889E+01	-.66274E-01	-.11467E-03	.44273E-02	0.	0.	0.	
30.00	SILICON	1.755	200.000	-.24273E+02	-.18263E+00	-.73759E-04	.86540E-02	.83658E+00	0.	0.	.345
30.00	TISSUE	1.755	200.000	-.21014E+02	-.23168E+00	-.26899E-03	.13892E-01	.10560E+01	0.	0.	.448
30.00	FLUENCE	2.200	200.000	-.13815E+01	-.27368E+00	-.41796E-03	.17316E-01	.14633E+01	0.	0.	
40.00	SILICON	11.040	170.400	-.22805E+02	-.17474E-01	.33951E-03	-.56114E-02	0.	0.	0.	.284
40.00	TISSUE	11.040	170.400	-.19151E+02	-.19139E-01	.40590E-03	-.61016E-02	0.	0.	0.	.363
40.00	FLUENCE	14.550	170.400	.12441E+01	.66771E-02	.59937E-03	-.10205E-01	0.	0.	0.	
50.00	SILICON	13.200	80.000	-.22404E+02	-.73639E-01	-.11900E-03	.42623E-02	0.	0.	0.	.221
50.00	TISSUE	13.200	80.000	-.18690E+02	-.85428E-01	-.13268E-03	.55091E-02	0.	0.	0.	.279
50.00	FLUENCE	13.200	80.000	.20102E+01	-.93235E-01	-.11662E-03	.58309E-02	0.	0.	0.	
60.00	SILICON	13.800	119.000	-.22220E+02	-.89555E-01	.27062E-04	.47552E-02	0.	0.	0.	.224
60.00	TISSUE	13.800	119.000	-.18750E+02	-.64323E-01	.34040E-03	-.88411E-03	0.	0.	0.	.165
60.00	FLUENCE	13.800	119.000	.20557E+01	-.10067E+00	.31344E-04	.49940E-02	0.	0.	0.	

SECONDARY GAMMAS

SAMPLING ALTITUDE (KM)	DOSE	MIN RHOR GM/CM2	MAX RHOR GM/CM2	FIT COEFFICIENTS A	B	C	D	E	F	G	RMS PCT DIFF
15.00	SILICON	114.200	192.500	-.22240E+02	-.23418E-01	0.	0.	0.	0.	0.	.317
15.00	TISSUE	114.200	192.500	-.22285E+02	-.24261E-01	0.	0.	0.	0.	0.	.317
15.00	FLUENCE	114.200	192.500	-.11500E+01	-.18617E-01	0.	0.	0.	0.	0.	
20.00	SILICON	46.240	198.500	-.23385E+02	.12850E-01	.15010E-03	-.40848E-02	0.	0.	0.	.341
20.00	TISSUE	46.240	198.500	-.23413E+02	.10470E-01	.15182E-03	-.39829E-02	0.	0.	0.	.357
20.00	FLUENCE	46.240	198.500	-.26257E+01	.45352E-01	.26976E-03	-.77044E-02	0.	0.	0.	
30.00	SILICON	1.755	180.000	-.28590E+02	-.30042E+00	.10419E-03	.77727E-02	.33043E+01	-.19328E+01	0.	.338
30.00	TISSUE	1.755	180.000	-.28376E+02	-.31832E+00	.77261E-04	.88966E-02	.35687E+01	-.23683E+01	0.	.343
30.00	FLUENCE	1.755	180.000	-.82383E+01	-.40287E+00	-.24800E-03	.18292E-01	.36873E+01	-.18048E+01	0.	
40.00	SILICON	11.040	170.400	-.24946E+02	.80907E-01	.51697E-03	-.14415E-01	0.	0.	0.	.533
40.00	TISSUE	11.040	170.400	-.24982E+02	.80970E-01	.51807E-03	-.14475E-01	0.	0.	0.	.523
40.00	FLUENCE	14.550	170.400	-.39862E+01	.11145E+00	.83396E-03	-.20559E-01	0.	0.	0.	
50.00	SILICON	13.200	143.700	-.24710E+02	.86716E-01	.89891E-03	-.19231E-01	0.	0.	0.	.253
50.00	TISSUE	13.200	143.700	-.24692E+02	.78583E-01	.82413E-03	-.17695E-01	0.	0.	0.	.248
50.00	FLUENCE	13.200	143.700	-.31872E+01	.33919E-01	.45859E-03	-.10158E-01	0.	0.	0.	
60.00	SILICON	13.800	119.000	-.24127E+02	.18188E-01	.41604E-03	-.81441E-02	0.	0.	0.	.321
60.00	TISSUE	13.800	119.000	-.24128E+02	.12040E-01	.35270E-03	-.68990E-02	0.	0.	0.	.325
60.00	FLUENCE	13.800	119.000	-.25035E+01	-.66468E-01	-.51958E-03	.87712E-02	0.	0.	0.	

TABLE 13

FIT COEFFICIENTS FOR MORSAIR RUN NO. 7
FISSION SOURCE IN REAL AIR AT 40 km

NEUTRONS

SAMPLING ALTITUDE (KM)	DOSE	MIN RHOR GM/CM2	MAX RHOR GM/CM2	A	B	C	D	E	F	G	RMS PCT DIFF
20.00	SILICON	54.830	179.300	-.22360E+02	-.45868E-01	.82744E-04	0.	0.	0.	0.	.412
20.00	TISSUE	54.830	179.300	-.18779E+02	-.42914E-01	.75636E-04	0.	0.	0.	0.	.458
20.00	FLUENCE	54.830	179.300	.20713E+01	-.31547E-01	.37861E-04	0.	0.	0.	0.	
30.00	SILICON	10.110	120.600	-.23292E+02	.27457E-01	.88112E-03	-.14985E-01	0.	0.	0.	.165
30.00	TISSUE	10.110	120.600	-.19568E+02	.93676E-02	.69360E-03	-.11245E-01	0.	0.	0.	.242
30.00	FLUENCE	11.610	120.600	.10180E+01	.23320E-01	.64291E-03	-.11643E-01	0.	0.	0.	
40.00	SILICON	.750	76.530	-.23855E+02	-.14843E+00	.19530E-03	.28186E-02	.56989E+00	0.	0.	.162
40.00	TISSUE	.750	76.530	-.20569E+02	-.20769E+00	.34600E-03	.56954E-02	.81747E+00	0.	0.	.243
40.00	FLUENCE	5.209	76.530	-.86160E+00	-.31961E+00	-.83743E-04	.17118E-01	.12907E+01	0.	0.	
60.00	SILICON	3.445	42.630	-.23164E+02	.52695E-01	.27931E-02	-.34911E-01	0.	0.	0.	.141
60.00	TISSUE	3.445	42.630	-.19599E+02	.65139E-01	.36063E-02	-.42967E-01	0.	0.	0.	.206
60.00	FLUENCE	4.985	42.630	.86529E+00	.22355E-01	.29530E-02	-.35842E-01	0.	0.	0.	
80.00	SILICON	3.661	32.420	-.23049E+02	.49839E-01	.43998E-02	-.44120E-01	0.	0.	0.	.080
80.00	TISSUE	3.661	32.420	-.19372E+02	.31242E-02	.33967E-02	-.32016E-01	0.	0.	0.	.148
80.00	FLUENCE	5.160	32.420	.11083E+01	-.60060E-01	.30257E-02	-.21719E-01	0.	0.	0.	
100.00	SILICON	3.674	24.550	-.22998E+02	.37395E-01	.42906E-02	-.42014E-01	0.	0.	0.	.037
100.00	TISSUE	3.674	24.550	-.19391E+02	.41190E-01	.57285E-02	-.51544E-01	0.	0.	0.	.053
100.00	FLUENCE	3.674	24.550	.11303E+01	-.20720E-01	.65226E-02	-.46881E-01	0.	0.	0.	

SECONDARY GAMMAS

SAMPLING ALTITUDE (KM)	DOSE	MIN RHOR GM/CM2	MAX RHOR GM/CM2	A	B	C	D	E	F	G	RMS PCT DIFF
20.00	SILICON	54.830	179.300	-.22869E+02	-.25431E-01	.21866E-04	0.	0.	0.	0.	.267
20.00	TISSUE	54.830	179.300	-.22953E+02	-.26393E-01	.25265E-04	0.	0.	0.	0.	.284
20.00	FLUENCE	54.830	179.300	-.14491E+01	-.24513E-01	.27114E-04	0.	0.	0.	0.	
30.00	SILICON	10.110	120.600	-.25957E+02	.19379E+00	.17652E-02	-.37945E-01	0.	0.	0.	.339
30.00	TISSUE	10.110	120.600	-.25999E+02	.19307E+00	.17762E-02	-.38040E-01	0.	0.	0.	.333
30.00	FLUENCE	11.610	120.600	-.46680E+01	.18181E+00	.15674E-02	-.34645E-01	0.	0.	0.	
40.00	SILICON	.750	72.660	-.33924E+02	.10303E+01	.74233E-02	-.14347E+00	-.96707E+01	.15262E+02	0.	.338
40.00	TISSUE	.750	72.660	-.33895E+02	.10604E+01	.75426E-02	.14660E+00	-.98482E+01	.15395E+02	0.	.331
40.00	FLUENCE	.750	76.530	-.97192E+01	-.37592E+00	.14518E-02	.10864E-02	.18255E+01	.16587E+01	0.	
60.00	SILICON	3.445	42.630	-.25987E+02	.38984E+00	.93974E-02	-.12357E+00	0.	0.	0.	.363
60.00	TISSUE	3.445	42.630	-.26013E+02	.39051E+00	.94016E-02	-.12357E+00	0.	0.	0.	.364
60.00	FLUENCE	4.985	42.630	-.48575E+01	.42693E+00	.11449E-01	-.14330E+00	0.	0.	0.	
80.00	SILICON	3.661	32.420	-.25552E+02	.36778E+00	.13739E-01	-.14674E+00	0.	0.	0.	.222
80.00	TISSUE	3.661	32.420	-.25594E+02	.37548E+00	.13961E-01	-.14909E+00	0.	0.	0.	.223
80.00	FLUENCE	3.661	32.420	-.44712E+01	.39940E+00	.15816E-01	-.16492E+00	0.	0.	0.	
100.00	SILICON	3.674	24.550	-.25204E+02	.28517E+00	.14306E-01	-.13592E+00	0.	0.	0.	.148
100.00	TISSUE	3.674	24.550	-.25253E+02	.29520E+00	.14619E-01	-.13911E+00	0.	0.	0.	.147
100.00	FLUENCE	3.674	24.550	-.39886E+01	.24631E+00	.14321E-01	-.13074E+00	0.	0.	0.	

TABLE 14

FIT COEFFICIENTS FOR MORSAIR RUN NO. 8
FISSION SOURCE IN REAL AIR AT 60 km

NEUTRONS

SAMPLING ALTITUDE (KM)	DOSE	MIN RHOR GM/CM2	MAX RHOR GM/CM2	FIT COEFFICIENTS A	B	C	D	E	F	G	RMS PCT DIFF
20.00	SILICON	56.790	108.100	-.21878E+02	-.65351E-01	.20671E-03	0.	0.	0.	0.	.658
20.00	TISSUE	56.790	108.100	-.18141E+02	-.66323E-01	.22364E-03	0.	0.	0.	0.	.681
20.00	FLUENCE	56.790	106.900	.30898E+01	-.63056E-01	.21235E-03	0.	0.	0.	0.	
40.00	SILICON	2.889	26.990	-.23467E+02	.18032E+00	.85084E-02	-.89034E-01	0.	0.	0.	.084
40.00	TISSUE	2.889	26.990	-.19948E+02	.19941E+00	.92402E-02	-.97582E-01	0.	0.	0.	.115
40.00	FLUENCE	2.889	26.990	.22309E+00	.30547E+00	.13710E-01	-.14184E+00	0.	0.	0.	
60.00	SILICON	.433	9.715	-.23627E+02	.21518E+00	.33371E-01	-.21193E+00	.28435E+00	0.	0.	.079
60.00	TISSUE	.433	9.715	-.20172E+02	.42987E+00	.58082E-01	-.35525E+00	.24646E+00	0.	0.	.110
60.00	FLUENCE	.150	9.715	-.22732E+00	.58734E+00	.94064E-01	-.54993E+00	.50382E+00	0.	0.	
80.00	SILICON	.318	5.139	-.23866E+02	.56880E-03	.13000E+00	-.47145E+00	.10101E+01	0.	0.	.034
80.00	TISSUE	.318	5.139	-.20790E+02	-.13417E+01	.43052E-01	.91824E-01	.23267E+01	0.	0.	.026
80.00	FLUENCE	.318	5.139	-.15804E+01	-.43113E+01	-.12917E+00	.12877E+01	.52480E+01	0.	0.	
100.00	SILICON	.286	3.451	-.24269E+02	-.30714E+01	-.16316E+00	.11588E+01	.31606E+01	0.	0.	.022
100.00	TISSUE	.286	3.451	-.20960E+02	-.35068E+01	-.12761E+00	.11755E+01	.37548E+01	0.	0.	.033
100.00	FLUENCE	.286	3.451	-.14938E+01	-.65347E+01	-.34480E+00	.25501E+01	.63111E+01	0.	0.	
120.00	SILICON	.287	2.484	-.23662E+02	-.28099E+00	.25821E+00	-.61196E+00	.11042E+01	0.	0.	.030
120.00	TISSUE	.287	2.484	-.20682E+02	-.34546E+01	-.15875E+00	.12769E+01	.33351E+01	0.	0.	.036
120.00	FLUENCE	.287	2.484	-.15379E+01	-.97723E+01	-.90953E+00	.49148E+01	.77475E+01	0.	0.	

SECONDARY GAMMAS

SAMPLING ALTITUDE (KM)	DOSE	MIN RHOR GM/CM2	MAX RHOR GM/CM2	FIT COEFFICIENTS A	B	C	D	E	F	G	RMS PCT DIFF
20.00	SILICON	56.790	108.100	-.22825E+02	-.32548E-01	.45252E-04	0.	0.	0.	0.	.450
20.00	TISSUE	56.790	108.100	-.22795E+02	-.36515E-01	.69348E-04	0.	0.	0.	0.	.455
20.00	FLUENCE	56.790	108.100	-.18118E+01	-.19239E-01	-.33364E-04	0.	0.	0.	0.	
40.00	SILICON	2.889	26.990	-.27084E+02	.97958E+00	.33171E-01	-.35801E+00	0.	0.	0.	.260
40.00	TISSUE	2.889	26.990	-.27094E+02	.97265E+00	.33016E-01	-.35591E+00	0.	0.	0.	.196
40.00	FLUENCE	2.889	26.990	-.58473E+01	.90362E+00	.30137E-01	-.32784E+00	0.	0.	0.	
60.00	SILICON	.150	9.715	-.28258E+02	-.15385E+02	-.37538E+00	.37884E+01	.42287E+02	-.28138E+02	0.	.106
60.00	TISSUE	.150	9.715	-.28401E+02	-.14848E+02	-.35979E+00	.36428E+01	.40715E+02	-.26849E+02	0.	.100
60.00	FLUENCE	.150	9.715	-.71881E+01	-.16180E+02	-.38386E+00	.39441E+01	.44760E+02	-.29974E+02	0.	
80.00	SILICON	.318	5.139	-.45556E+02	.11959E+02	.40225E+00	-.28883E+01	-.69518E+02	.80104E+02	0.	.099
80.00	TISSUE	.318	5.139	-.45247E+02	.11582E+02	.39873E+00	-.28192E+01	-.67759E+02	.78333E+02	0.	.092
80.00	FLUENCE	.318	5.139	-.19798E+02	.23989E+01	.12148E+00	-.33018E+00	-.37120E+02	.50294E+02	0.	
100.00	SILICON	.286	3.451	-.76525E+02	.93093E+02	.40750E+01	-.28708E+02	-.31588E+03	.29846E+03	0.	.108
100.00	TISSUE	.286	3.451	-.79323E+02	.10200E+03	.45831E+01	-.31936E+02	-.33943E+03	.31862E+03	0.	.108
100.00	FLUENCE	.286	3.451	-.43609E+02	.65867E+02	.29981E+01	-.29447E+02	-.23070E+03	.22145E+03	0.	
120.00	SILICON	.287	2.484	-.15242E+02	-.10889E+03	-.93440E+01	.49346E+02	.20036E+03	-.14178E+03	0.	.108
120.00	TISSUE	.287	2.484	-.12222E+02	-.11853E+03	-.99537E+01	.52955E+02	.22589E+03	-.16370E+03	0.	.107
120.00	FLUENCE	.287	2.484	-.39149E+01	-.66491E+02	-.59583E+01	.31301E+02	.10336E+03	-.62829E+02	0.	

TABLE 15

FIT COEFFICIENTS FOR MORSAIR RUN NO. 9
FISSION SOURCE IN REAL AIR AT 80 km

NEUTRONS

SAMPLING ALTITUDE (KM)	DOSE	MIN RHOR GM/CM2	MAX RHOR GM/CM2	FIT COEFFICIENTS A	B	C	D	E	F	G	RMS PCT DIFF
20.00	SILICON	56.900	64.860	-.51858E+02	.91675E+00	-.78435E-02	0.	0.	0.	0.	.674
20.00	TISSUE	56.900	64.860	-.36148E+02	.52232E+00	-.46094E-02	0.	0.	0.	0.	.762
20.00	FLUENCE	56.900	64.860	.23901E+02	-.76685E+00	.61491E-02	0.	0.	0.	0.	
40.00	SILICON	3.008	12.900	-.23769E+02	.62712E+00	.45274E-01	-.34021E+00	0.	0.	0.	.199
40.00	TISSUE	3.008	12.900	-.19987E+02	.38252E+00	.25320E-01	-.20815E+00	0.	0.	0.	.210
40.00	FLUENCE	3.087	12.510	.42449E+00	.33607E+00	.22316E-01	-.19058E+00	0.	0.	0.	
60.00	SILICON	.267	3.404	-.24196E+02	-.20753E+01	-.15407E+00	.81885E+00	.23818E+01	0.	0.	.044
60.00	TISSUE	.267	3.404	-.20780E+02	-.15903E+01	-.36117E-01	.34894E+00	.23605E+01	0.	0.	.052
60.00	FLUENCE	.267	3.404	-.13456E+01	-.36844E+01	-.14925E+00	.11517E+01	.45133E+01	0.	0.	
80.00	SILICON	.059	.832	-.23515E+02	.49834E+01	.34333E+01	-.79317E+01	-.32355E+00	0.	0.	.066
80.00	TISSUE	.059	.832	-.20070E+02	.68190E+01	.56607E+01	-.11763E+02	-.43704E+00	0.	0.	.108
80.00	FLUENCE	.100	.832	-.53213E-01	.11502E+02	.10765E+02	-.21245E+02	-.70775E+00	0.	0.	
100.00	SILICON	.026	.289	-.23763E+02	.29818E+01	.26813E+02	-.25683E+02	.26077E+01	0.	0.	.032
100.00	TISSUE	.026	.289	-.20525E+02	-.82720E+01	.13827E+02	-.65581E+01	.55429E+01	0.	0.	.047
100.00	FLUENCE	.015	.245	-.83641E+00	-.19532E+02	.14851E+02	.83488E+00	.98539E+01	0.	0.	
120.00	SILICON	.015	.153	-.24425E+02	-.71950E+02	-.13653E+03	.15688E+03	.15278E+02	0.	0.	.016
120.00	TISSUE	.015	.153	-.21107E+02	-.75330E+02	-.11979E+03	.14961E+03	.17117E+02	0.	0.	.025
120.00	FLUENCE	.015	.153	-.14524E+01	-.93281E+02	-.92046E+02	.15370E+03	.22897E+02	0.	0.	
140.00	SILICON	.015	.114	-.24050E+02	-.38419E+02	-.40625E+02	.62072E+02	.98285E+01	0.	0.	.018
140.00	TISSUE	.015	.114	-.20653E+02	-.34633E+02	.81084E+01	.29907E+02	.10591E+02	0.	0.	.021
140.00	FLUENCE	.015	.114	-.97036E+00	-.58952E+02	.38820E+02	.45140E+02	.17012E+02	0.	0.	

SECONDARY GAMMAS

SAMPLING ALTITUDE (KM)	DOSE	MIN RHOR GM/CM2	MAX RHOR GM/CM2	FIT COEFFICIENTS A	B	C	D	E	F	G	RMS PCT DIFF
20.00	SILICON	56.900	64.860	.34551E+02	-.19492E+01	.15994E-01	0.	0.	0.	0.	.641
20.00	TISSUE	56.900	64.860	.40026E+02	-.21340E+01	.17516E-01	0.	0.	0.	0.	.660
20.00	FLUENCE	56.900	64.860	.15987E+02	-.62138E+00	.50163E-02	0.	0.	0.	0.	
40.00	SILICON	3.008	12.900	-.26538E+02	.10532E+01	.50094E-01	-.46112E+00	0.	0.	0.	.295
40.00	TISSUE	3.008	12.900	-.26578E+02	.10624E+01	.50818E-01	-.46590E+00	0.	0.	0.	.294
40.00	FLUENCE	3.008	12.900	-.58976E+01	.15349E+01	.86427E-01	-.71227E+00	0.	0.	0.	
60.00	SILICON	.267	3.404	.58018E+01	-.13981E+03	-.79414E+01	.50730E+02	.34798E+03	-.28225E+03	0.	.173
60.00	TISSUE	.267	3.404	.78355E+01	-.14549E+03	-.82251E+01	.52651E+02	.36421E+03	-.29648E+03	0.	.170
60.00	FLUENCE	.267	3.404	.10065E+02	-.87447E+02	-.48666E+01	.31608E+02	.20803E+03	-.16182E+03	0.	
80.00	SILICON	.020	.832	-.38447E+02	.24428E+02	.17594E+02	-.31800E+02	-.63316E+02	.65661E+02	0.	.125
80.00	TISSUE	.020	.832	-.38282E+02	.18565E+02	.15203E+02	-.25948E+02	-.58011E+02	.62565E+02	0.	.121
80.00	FLUENCE	.020	.832	-.15798E+02	-.24543E+02	-.51380E+00	.14584E+02	-.18497E+02	.39544E+02	0.	
100.00	SILICON	.015	.289	-.35340E+02	-.17428E+03	-.11406E+03	.23897E+03	.25333E+02	.27582E+02	0.	.091
100.00	TISSUE	.015	.289	-.34753E+02	-.19619E+03	-.12864E+03	.26590E+03	.42859E+02	.17549E+02	0.	.088
100.00	FLUENCE	.015	.289	-.17112E+02	-.82608E+02	-.64207E+02	.13665E+03	-.53790E+02	.73672E+02	0.	
120.00	SILICON	.015	.153	-.65284E+02	.13184E+04	.13131E+04	-.19160E+04	-.10062E+04	.58885E+03	0.	.054
120.00	TISSUE	.015	.153	-.62926E+02	.11891E+04	.11768E+04	-.17173E+04	-.92320E+03	.54448E+03	0.	.049
120.00	FLUENCE	.015	.153	-.29660E+02	.38301E+03	.21920E+03	-.38551E+03	-.45605E+03	.30331E+03	0.	
140.00	SILICON	.015	.114	-.95476E+02	.35210E+04	.44316E+04	-.58120E+04	-.22419E+04	.12190E+04	0.	.005
140.00	TISSUE	.015	.114	-.92801E+02	.33746E+04	.42745E+04	-.55859E+04	-.21480E+04	.11687E+04	0.	.001
140.00	FLUENCE	.015	.114	-.51749E+02	.19417E+04	.23452E+04	-.30771E+04	-.13543E+04	.76409E+03	0.	

TABLE 16

FIT COEFFICIENTS FOR MORSAIR RUN NO. 10
THERMONUCLEAR SOURCE IN A HOMOGENEOUS ATMOSPHERE

NEUTRONS

SAMPLING ALTITUDE (KM)	DOSE	MIN RHOR GM/CM2	MAX RHOR GM/CM2	A	B	C	D	E	F	G	RMS PCT DIFF
				FIT COEFFICIENTS							
3.11	SILICON	101.600	192.600	-.20836E+02	-.40110E-01	0.	0.	0.	0.	0.	.831
3.11	TISSUE	101.600	192.600	-.18043E+02	-.37306E-01	0.	0.	0.	0.	0.	.889
3.11	FLUENCE	101.600	192.600	.26092E+01	-.33455E-01	0.	0.	0.	0.	0.	
3.83	SILICON	21.800	192.900	-.22309E+02	.43977E-02	.15232E-03	-.47837E-02	0.	0.	0.	.310
3.83	TISSUE	21.800	192.900	-.19739E+02	.23693E-01	.19553E-03	-.64761E-02	0.	0.	0.	.272
3.83	FLUENCE	21.800	177.500	.15816E+01	.38390E-01	.33873E-03	-.96085E-02	0.	0.	0.	
4.01	SILICON	3.647	200.000	-.22338E+02	.14645E-01	.10865E-03	-.47114E-02	-.53114E-01	0.	0.	.308
4.01	TISSUE	3.647	200.000	-.20209E+02	.20062E-01	.25930E-03	-.75568E-02	.12794E+00	0.	0.	.228
4.01	FLUENCE	8.737	200.000	-.40209E+00	-.11352E+00	.29659E-04	.16081E-02	.90695E+00	0.	0.	
4.92	SILICON	101.600	200.000	-.20935E+02	-.40879E-01	0.	0.	0.	0.	0.	.639
4.92	TISSUE	101.600	200.000	-.17741E+02	-.40140E-01	0.	0.	0.	0.	0.	.671
4.92	FLUENCE	101.600	200.000	.31649E+01	-.38262E-01	0.	0.	0.	0.	0.	

SECONDARY GAMMAS

SAMPLING ALTITUDE (KM)	DOSE	MIN RHOR GM/CM2	MAX RHOR GM/CM2	A	B	C	D	E	F	G	RMS PCT DIFF
				FIT COEFFICIENTS							
3.11	SILICON	101.600	192.600	-.20982E+02	-.23424E-01	0.	0.	0.	0.	0.	.395
3.11	TISSUE	101.600	192.600	-.21172E+02	-.22957E-01	0.	0.	0.	0.	0.	.369
3.11	FLUENCE	101.600	192.600	.67622E+00	-.24603E-01	0.	0.	0.	0.	0.	
3.83	SILICON	21.800	192.900	-.23328E+02	.79339E-01	.39443E-03	-.11961E-01	0.	0.	0.	.312
3.83	TISSUE	21.800	192.900	-.23365E+02	.78160E-01	.40735E-03	-.12070E-01	0.	0.	0.	.328
3.83	FLUENCE	21.800	192.900	-.25099E+01	.10796E+00	.47454E-03	-.14890E-01	0.	0.	0.	
4.01	SILICON	.091	200.000	-.36942E+02	.64668E+00	.91430E-03	-.37779E-01	-.12623E+02	.22353E+02	0.	.294
4.01	TISSUE	.091	200.000	-.36954E+02	.64134E+00	.89528E-03	-.37208E-01	-.12618E+02	.22351E+02	0.	.302
4.01	FLUENCE	.091	200.000	-.15962E+02	.53115E+00	.76242E-03	-.31215E-01	-.11079E+02	.20541E+02	0.	
4.92	SILICON	101.600	200.000	-.21176E+02	-.21935E-01	0.	0.	0.	0.	0.	.402
4.92	TISSUE	101.600	200.000	-.21290E+02	-.22005E-01	0.	0.	0.	0.	0.	.431
4.92	FLUENCE	101.600	200.000	.22201E+00	-.20591E-01	0.	0.	0.	0.	0.	

TABLE 17

FIT COEFFICIENTS FOR MORSAIR RUN NO. 11
THERMONUCLEAR SOURCE IN REAL AIR AT 20 km

NEUTRONS

SAMPLING ALTITUDE (KM)	DOSE	MIN RHOR GM/CM2	MAX RHOR GM/CM2	A	B	C	D	E	F	G	RMS PCT DIFF
12.09	SILICON	146.500	195.400	-.20692E+02	-.42995E-01	0.	0.	0.	0.	0.	1.473
12.09	TISSUE	146.500	195.400	-.18236E+02	-.37290E-01	0.	0.	0.	0.	0.	1.548
14.85	SILICON	77.770	200.000	-.21656E+02	-.35910E-01	-.72997E-05	0.	0.	0.	0.	.729
14.85	TISSUE	77.770	200.000	-.18524E+02	-.34334E-01	-.67039E-05	0.	0.	0.	0.	.602
14.85	FLUENCE	77.770	185.700	.24495E+01	-.32107E-01	-.50334E-05	0.	0.	0.	0.	
20.61	SILICON	4.149	193.900	-.22331E+02	-.86490E-03	.21781E-03	-.49696E-02	0.	0.	0.	.224
20.61	TISSUE	4.149	193.900	-.19995E+02	.35031E-01	.35374E-03	-.89595E-02	0.	0.	0.	.265
20.61	FLUENCE	10.690	165.500	.79365E+00	.88305E-01	.65211E-03	-.16821E-01	0.	0.	0.	
22.08	SILICON	13.370	195.400	-.21748E+02	-.70137E-01	-.29790E-03	.69409E-02	0.	0.	0.	.393
22.08	TISSUE	13.370	195.400	-.19534E+02	-.50942E-02	.11882E-03	-.29363E-02	0.	0.	0.	.273
22.08	FLUENCE	19.220	195.400	.16448E+01	.21521E-01	.31566E-03	-.75428E-02	0.	0.	0.	
26.13	SILICON	32.110	197.500	-.20589E+02	-.12496E+00	-.44231E-03	.12321E-01	0.	0.	0.	.507
26.13	TISSUE	32.110	197.500	-.18364E+02	-.76521E-01	-.16006E-03	.55899E-02	0.	0.	0.	.302
26.13	FLUENCE	32.110	197.500	.29155E+01	-.71574E-01	-.88452E-04	.44492E-02	0.	0.	0.	
34.72	SILICON	47.910	196.800	-.21070E+02	-.60655E-01	.36189E-04	.13831E-02	0.	0.	0.	.415
34.72	TISSUE	47.910	196.800	-.17800E+02	-.99338E-01	-.15961E-03	.69969E-02	0.	0.	0.	.395
34.72	FLUENCE	53.350	182.700	.28118E+01	-.73619E-01	-.18630E-04	.34209E-02	0.	0.	0.	

SECONDARY GAMMAS

SAMPLING ALTITUDE (KM)	DOSE	MIN RHOR GM/CM2	MAX RHOR GM/CM2	A	B	C	D	E	F	G	RMS PCT DIFF
12.09	SILICON	146.500	195.400	-.22964E+02	-.15299E-01	0.	0.	0.	0.	0.	.425
12.09	TISSUE	146.500	195.400	-.22656E+02	-.18490E-01	0.	0.	0.	0.	0.	.535
14.85	SILICON	77.770	200.000	-.21512E+02	-.26594E-01	.22296E-04	0.	0.	0.	0.	.382
14.85	TISSUE	77.770	200.000	-.21637E+02	-.26885E-01	.20379E-04	0.	0.	0.	0.	.423
14.85	FLUENCE	77.770	200.000	-.47952E-01	-.19313E-01	-.48395E-05	0.	0.	0.	0.	
20.61	SILICON	4.149	193.900	-.24337E+02	.14062E+00	.70977E-03	-.20479E-01	0.	0.	0.	.477
20.61	TISSUE	4.149	193.900	-.24337E+02	.13469E+00	.67810E-03	-.19732E-01	0.	0.	0.	.494
20.61	FLUENCE	10.690	193.900	-.36402E+01	.18342E+00	.90313E-03	-.25783E-01	0.	0.	0.	
22.08	SILICON	13.370	195.400	-.23768E+02	.98639E-01	.48708E-03	-.14523E-01	0.	0.	0.	.370
22.08	TISSUE	13.370	195.400	-.23781E+02	.95659E-01	.47156E-03	-.14192E-01	0.	0.	0.	.372
22.08	FLUENCE	19.220	195.400	-.28989E+01	.12772E+00	.60962E-03	-.17928E-01	0.	0.	0.	
26.13	SILICON	32.110	197.500	-.23197E+02	.70643E-01	.42800E-03	-.11795E-01	0.	0.	0.	.291
26.13	TISSUE	32.110	197.500	-.23184E+02	.64540E-01	.39305E-03	-.10955E-01	0.	0.	0.	.294
26.13	FLUENCE	32.110	197.500	-.20525E+01	.73918E-01	.41284E-03	-.11635E-01	0.	0.	0.	
34.72	SILICON	47.910	196.800	-.22693E+02	.36091E-01	.27694E-03	-.74619E-02	0.	0.	0.	.275
34.72	TISSUE	47.910	196.800	-.22782E+02	.39205E-01	.29716E-03	-.79559E-02	0.	0.	0.	.275
34.72	FLUENCE	47.910	182.700	-.10306E+01	.13698E-01	.16494E-03	-.45256E-02	0.	0.	0.	

TABLE 18

FIT COEFFICIENTS FOR MORSAIR RUN NO. 12
THERMONUCLEAR SOURCE IN REAL AIR AT 30 km

NEUTRONS

SAMPLING ALTITUDE (KM)	DOSE	MIN RHOR GM/CM2	MAX RHOR GM/CM2	FIT COEFFICIENTS A	B	C	D	E	F	G	RMS PCT DIFF
15.00	SILICON	114.200	175.000	-.21861E+02	-.35099E-01	0.	0.	0.	0.	0.	1.218
15.00	TISSUE	114.200	175.000	-.19699E+02	-.27021E-01	0.	0.	0.	0.	0.	.934
15.00	FLUENCE	114.200	175.000	.11590E+01	-.24771E-01	0.	0.	0.	0.	0.	
20.00	SILICON	46.240	175.000	-.20635E+02	-.12172E+00	-.25685E-03	.98193E-02	0.	0.	0.	.409
20.00	TISSUE	46.240	175.000	-.18674E+02	-.67815E-01	-.86811E-04	.41246E-02	0.	0.	0.	.275
20.00	FLUENCE	46.240	175.000	.29042E+01	-.70954E-01	-.72538E-04	.40776E-02	0.	0.	0.	
30.00	SILICON	1.755	200.000	-.23105E+02	-.17582E+00	-.59160E-04	.81072E-02	.71766E+00	0.	0.	.430
30.00	TISSUE	1.755	200.000	-.20938E+02	-.19449E+00	-.21156E-03	.11293E-01	.85378E+00	0.	0.	.342
30.00	FLUENCE	12.200	168.400	-.13716E+01	-.33091E+00	-.58992E-03	.22932E-01	.16292E+01	0.	0.	
40.00	SILICON	11.040	156.000	-.22856E+02	.94031E-01	.10934E-02	-.24118E-01	0.	0.	0.	.321
40.00	TISSUE	11.040	156.000	-.19958E+02	.54668E-01	.89544E-03	-.17979E-01	0.	0.	0.	.211
40.00	FLUENCE	11.040	170.400	.14873E+01	-.20074E-01	.36654E-03	-.57490E-02	0.	0.	0.	
50.00	SILICON	13.200	143.700	-.21409E+02	-.11752E+00	-.74157E-03	.14178E-01	0.	0.	0.	.487
50.00	TISSUE	13.200	136.000	-.18873E+02	-.10309E+00	-.46226E-03	.10404E-01	0.	0.	0.	.323
50.00	FLUENCE	13.200	143.700	.22202E+01	-.12871E+00	-.37005E-03	.11667E-01	0.	0.	0.	
60.00	SILICON	13.800	105.000	-.20106E+02	-.33355E+00	-.28823E-02	.56760E-01	0.	0.	0.	.648
60.00	TISSUE	13.800	119.000	-.17608E+02	-.31538E+00	-.25667E-02	.51918E-01	0.	0.	0.	.602
60.00	FLUENCE	13.800	119.000	.28884E+01	-.25175E+00	-.16389E-02	.36145E-01	0.	0.	0.	

SECONDARY GAMMAS

SAMPLING ALTITUDE (KM)	DOSE	MIN RHOR GM/CM2	MAX RHOR GM/CM2	FIT COEFFICIENTS A	B	C	D	E	F	G	RMS PCT DIFF
15.00	SILICON	114.200	192.500	-.22308E+02	-.20820E-01	0.	0.	0.	0.	0.	.313
15.00	TISSUE	114.200	192.500	-.22538E+02	-.20719E-01	0.	0.	0.	0.	0.	.303
15.00	FLUENCE	114.200	192.500	-.16965E+00	-.22125E-01	0.	0.	0.	0.	0.	
20.00	SILICON	46.240	198.500	-.22112E+02	-.23204E-01	.30690E-04	-.17383E-03	0.	0.	0.	.260
20.00	TISSUE	46.240	198.500	-.22256E+02	-.19901E-01	.56505E-04	-.80026E-03	0.	0.	0.	.281
20.00	FLUENCE	46.240	198.500	-.11598E+01	.96782E-02	.15141E-03	-.37792E-02	0.	0.	0.	
30.00	SILICON	1.755	200.000	-.23441E+02	-.78589E+00	-.11514E-02	.47348E-01	.87746E+01	-.99387E+01	0.	.300
30.00	TISSUE	1.755	200.000	-.23303E+02	-.80925E+00	-.12101E-02	.49187E-01	.90370E+01	-.10320E+02	0.	.308
30.00	FLUENCE	1.755	200.000	-.38715E+01	-.68678E+00	-.89892E-03	.39588E-01	.74814E+01	-.77550E+01	0.	
40.00	SILICON	11.040	80.000	-.23147E+02	.11429E-01	.30786E-04	-.30188E-02	0.	0.	0.	.483
40.00	TISSUE	11.040	80.000	-.23177E+02	.10409E-01	.24293E-04	-.28526E-02	0.	0.	0.	.475
40.00	FLUENCE	14.550	80.000	-.23491E+01	.56957E-01	.43853E-03	-.11528E-01	0.	0.	0.	
50.00	SILICON	13.200	143.700	-.23436E+02	.84435E-01	.10059E-02	-.19928E-01	0.	0.	0.	.226
50.00	TISSUE	13.200	129.000	-.23522E+02	.90950E-01	.10530E-02	-.20993E-01	0.	0.	0.	.208
50.00	FLUENCE	13.200	136.000	-.24581E+01	.10009E+00	.11322E-02	-.22983E-01	0.	0.	0.	
60.00	SILICON	13.800	119.000	-.22059E+02	-.12683E+00	-.11009E-02	.20920E-01	0.	0.	0.	.446
60.00	TISSUE	13.800	119.000	-.22081E+02	-.12878E+00	-.11251E-02	.21362E-01	0.	0.	0.	.454
60.00	FLUENCE	17.730	119.000	-.57843E+00	-.15464E+00	-.12006E-02	.23913E-01	0.	0.	0.	

TABLE 19

FIT COEFFICIENTS FOR MORSAIR RUN NO. 13
THERMONUCLEAR SOURCE IN REAL AIR AT 40 km

NEUTRONS

SAMPLING ALTITUDE (KM)	DOSE	MIN RHOR GM/CM2	MAX RHOR GM/CM2	FIT COEFFICIENTS A	B	C	D	E	F	G	RMS PCT DIFF
20.00	SILICON	54.830	179.300	-.21241E+02	-.60396E-01	.15031E-03	0.	0.	0.	0.	.460
20.00	TISSUE	54.830	179.300	-.18954E+02	-.44357E-01	.91314E-04	0.	0.	0.	0.	.388
20.00	FLUENCE	56.890	179.300	.19585E+01	-.38562E-01	.73558E-04	0.	0.	0.	0.	
30.00	SILICON	10.110	115.600	-.22307E+02	.75666E-01	.14240E-02	-.25323E-01	0.	0.	0.	.193
30.00	TISSUE	10.110	120.600	-.20132E+02	.56364E-01	.11223E-02	-.19933E-01	0.	0.	0.	.162
30.00	FLUENCE	11.610	120.600	.11573E+01	.17437E-01	.74588E-03	-.12317E-01	0.	0.	0.	
40.00	SILICON	.750	76.530	-.22234E+02	.83717E-01	.85599E-03	-.21043E-01	-.18905E+00	0.	0.	.108
40.00	TISSUE	.750	76.530	-.20453E+02	-.86697E-01	.70074E-03	-.66707E-02	.43923E+00	0.	0.	.164
40.00	FLUENCE	.750	76.530	-.87887E+00	-.41975E+00	-.73868E-03	.30704E-01	.15103E+01	0.	0.	
60.00	SILICON	3.445	42.630	-.22252E+02	-.37580E-02	.20131E-03	-.84972E-02	0.	0.	0.	.108
60.00	TISSUE	3.445	42.630	-.19711E+02	-.29062E-01	-.58518E-03	-.16935E-02	0.	0.	0.	.198
60.00	FLUENCE	4.985	42.630	.12079E+01	-.11304E+00	-.20427E-04	.33652E-02	0.	0.	0.	
80.00	SILICON	3.661	32.420	-.22059E+02	-.80960E-01	-.22222E-02	.16669E-01	0.	0.	0.	.123
80.00	TISSUE	3.661	32.420	-.19587E+02	-.32802E-01	.95978E-03	-.10901E-01	0.	0.	0.	.114
80.00	FLUENCE	3.661	32.420	.13427E+01	-.14459E+00	.12514E-02	.44022E-03	0.	0.	0.	
100.00	SILICON	3.674	24.550	-.22065E+02	-.81768E-01	-.31374E-02	.20339E-01	0.	0.	0.	.065
100.00	TISSUE	3.674	24.550	-.19515E+02	-.55237E-01	.55511E-03	-.55160E-02	0.	0.	0.	.072
100.00	FLUENCE	3.674	24.550	.15515E+01	-.24794E+00	-.10934E-02	.32076E-01	0.	0.	0.	

SECONDARY GAMMAS

SAMPLING ALTITUDE (KM)	DOSE	MIN RHOR GM/CM2	MAX RHOR GM/CM2	FIT COEFFICIENTS A	B	C	D	E	F	G	RMS PCT DIFF
20.00	SILICON	54.830	179.300	-.22171E+02	-.28237E-01	.35360E-04	0.	0.	0.	0.	.296
20.00	TISSUE	54.830	179.300	-.22220E+02	-.30377E-01	.42932E-04	0.	0.	0.	0.	.317
20.00	FLUENCE	54.830	179.300	-.67739E+00	-.23263E-01	.20713E-04	0.	0.	0.	0.	
30.00	SILICON	10.110	120.600	-.24223E+02	.13450E+00	.13331E-02	-.28345E-01	0.	0.	0.	.364
30.00	TISSUE	10.110	120.600	-.24250E+02	.13250E+00	.13345E-02	-.28232E-01	0.	0.	0.	.366
30.00	FLUENCE	11.610	120.600	-.31934E+01	.15409E+00	.14374E-02	-.30670E-01	0.	0.	0.	
40.00	SILICON	.750	76.530	-.24992E+02	-.15488E+01	-.47785E-02	.13550E+00	.11443E+02	-.10692E+02	0.	.255
40.00	TISSUE	.750	76.530	-.25263E+02	-.14565E+01	-.44242E-02	.12660E+00	.10629E+02	-.97004E+01	0.	.250
40.00	FLUENCE	.750	76.530	-.31969E+01	-.21587E+01	-.70956E-02	.19570E+00	.16364E+02	-.16227E+02	0.	
60.00	SILICON	3.445	42.630	-.24440E+02	.36260E+00	.89157E-02	-.11463E+00	0.	0.	0.	.355
60.00	TISSUE	3.445	42.630	-.24472E+02	.36520E+00	.89397E-02	-.11513E+00	0.	0.	0.	.347
60.00	FLUENCE	4.985	42.630	-.35257E+01	.42273E+00	.10689E-01	-.13677E+00	0.	0.	0.	
80.00	SILICON	3.661	32.420	-.23866E+02	.20011E+00	.64641E-02	-.75654E-01	0.	0.	0.	.234
80.00	TISSUE	3.661	32.420	-.23905E+02	.20573E+00	.65680E-02	-.77075E-01	0.	0.	0.	.229
80.00	FLUENCE	5.160	32.420	-.27478E+01	.19095E+00	.72226E-02	-.81128E-01	0.	0.	0.	
100.00	SILICON	3.674	24.550	-.23639E+02	.14126E+00	.60704E-02	-.64362E-01	0.	0.	0.	.169
100.00	TISSUE	3.674	24.550	-.23678E+02	.14757E+00	.61680E-02	-.65950E-01	0.	0.	0.	.169
100.00	FLUENCE	3.674	24.550	-.25126E+01	.13374E+00	.78796E-02	-.75415E-01	0.	0.	0.	

TABLE 20

FIT COEFFICIENTS FOR MORSAIR RUN NO. 14
THERMONUCLEAR SOURCE IN REAL AIR AT 60 km

NEUTRONS

SAMPLING ALTITUDE (KM)	DOSE	MIN RHOR GM/CM2	MAX RHOR GM/CM2	FIT COEFFICIENTS A	B	C	D	E	F	G	RMS PCT DIFF
20.00	SILICON	56.790	108.100	-.21896E+02	-.49680E-01	.97844E-04	0.	0.	0.	0.	.849
20.00	TISSUE	56.790	108.100	-.19215E+02	-.43698E-01	.87604E-04	0.	0.	0.	0.	.688
20.00	FLUENCE	56.790	108.100	.11895E+01	-.26746E-01	-.70539E-05	0.	0.	0.	0.	
40.00	SILICON	2.889	26.990	-.22189E+02	-.12772E+00	-.61047E-02	.44101E-01	0.	0.	0.	.145
40.00	TISSUE	2.889	26.990	-.19970E+02	.57673E-01	.27443E-02	-.36538E-01	0.	0.	0.	.162
40.00	FLUENCE	3.194	26.990	.49316E+00	.18902E+00	.11511E-01	-.11091E+00	0.	0.	0.	
60.00	SILICON	.150	9.715	-.22134E+02	.14918E+01	.11838E+00	-.75026E+00	-.10654E+01	0.	0.	.048
60.00	TISSUE	.150	9.715	-.20082E+02	.12306E+01	.11326E+00	-.70468E+00	-.53205E+00	0.	0.	.057
60.00	FLUENCE	.740	9.715	-.35342E+00	.34110E+00	.10526E+00	-.53998E+00	.84360E+00	0.	0.	
80.00	SILICON	.318	5.139	-.22772E+02	-.93205E+00	-.43473E-01	.30111E+00	.11863E+01	0.	0.	.033
80.00	TISSUE	.318	5.139	-.20985E+02	-.20199E+01	-.59545E-01	.57293E+00	.26271E+01	0.	0.	.026
80.00	FLUENCE	.318	5.139	-.19236E+01	-.62934E+01	-.31576E+00	.23037E+01	.67420E+01	0.	0.	
100.00	SILICON	.286	3.451	-.23275E+02	-.42868E+01	-.47536E+00	.23168E+01	.34772E+01	0.	0.	.046
100.00	TISSUE	.286	3.451	-.21441E+02	-.57370E+01	-.47387E+00	.26826E+01	.51165E+01	0.	0.	.044
100.00	FLUENCE	.286	3.451	-.20691E+01	-.10246E+02	-.77236E+00	.46636E+01	.89003E+01	0.	0.	
120.00	SILICON	.287	2.484	-.23066E+02	-.32716E+01	-.32066E+00	.16576E+01	.27639E+01	0.	0.	.030
120.00	TISSUE	.287	2.484	-.21065E+02	-.46415E+01	-.33453E+00	.20675E+01	.41108E+01	0.	0.	.029
120.00	FLUENCE	.287	2.484	-.23554E+01	-.15879E+02	-.18317E+01	.88730E+01	.11613E+02	0.	0.	

SECONDARY GAMMAS

SAMPLING ALTITUDE (KM)	DOSE	MIN RHOR GM/CM2	MAX RHOR GM/CM2	FIT COEFFICIENTS A	B	C	D	E	F	G	RMS PCT DIFF
20.00	SILICON	56.790	108.100	-.20669E+02	-.70486E-01	.27690E-03	0.	0.	0.	0.	.454
20.00	TISSUE	56.790	108.100	-.20738E+02	-.72210E-01	.28204E-03	0.	0.	0.	0.	.472
20.00	FLUENCE	56.790	108.100	.13706E+00	-.47585E-01	.14795E-03	0.	0.	0.	0.	
40.00	SILICON	2.889	26.990	-.25177E+02	.68621E+00	.20442E-01	-.23689E+00	0.	0.	0.	.219
40.00	TISSUE	2.889	26.990	-.25195E+02	.67655E+00	.19974E-01	-.23268E+00	0.	0.	0.	.223
40.00	FLUENCE	3.194	26.990	-.42813E+01	.76608E+00	.23313E-01	-.26610E+00	0.	0.	0.	
60.00	SILICON	.150	9.715	-.28596E+02	-.10630E+02	-.27014E+00	.26826E+01	.25682E+02	-.13408E+02	0.	.069
60.00	TISSUE	.150	9.715	-.28725E+02	-.10376E+02	-.26457E+00	.26231E+01	.24791E+02	-.12610E+02	0.	.068
60.00	FLUENCE	.150	9.715	-.10789E+02	-.58781E+01	-.12495E+00	.14160E+01	.79415E+01	.38368E+01	0.	
80.00	SILICON	.318	5.139	-.35269E+02	-.56010E+01	-.38341E+00	.26455E+01	-.11737E+02	.26355E+02	0.	.059
80.00	TISSUE	.318	5.139	-.36086E+02	-.34919E+01	-.29106E+00	.19710E+01	-.17926E+02	.31812E+02	0.	.059
80.00	FLUENCE	.318	5.139	-.13099E+02	-.11050E+02	-.61399E+00	.44032E+01	.19808E+01	.15363E+02	0.	
100.00	SILICON	.286	3.451	-.38210E+02	.31458E+01	-.11881E+00	.47928E+00	-.43540E+02	.54357E+02	0.	.069
100.00	TISSUE	.286	3.451	-.38210E+02	.34964E+01	-.84035E-01	.29357E+00	-.43866E+02	.54485E+02	0.	.065
100.00	FLUENCE	.286	3.451	-.15094E+02	-.73613E+01	-.79199E+00	.45960E+01	-.20243E+02	.35939E+02	0.	
120.00	SILICON	.287	2.484	-.48734E+02	.39546E+02	.19859E+01	-.12552E+02	-.14134E+03	.13717E+03	0.	.077
120.00	TISSUE	.287	2.484	-.52975E+02	.54782E+02	.30437E+01	-.18588E+02	-.17896E+03	.16876E+03	0.	.078
120.00	FLUENCE	.287	2.484	-.28063E+02	.38380E+02	.19489E+01	-.12060E+02	-.14141E+03	.13818E+03	0.	

TABLE 21

FIT COEFFICIENTS FOR MORSAIR RUN NO. 15
THERMONUCLEAR SOURCE IN REAL AIR AT 80 km

NEUTRONS

SAMPLING ALTITUDE (KM)	DOSE	MIN RHOR GM/CM2	MAX RHOR GM/CM2	FIT COEFFICIENTS A	B	C	D	E	F	G	RMS PCT DIFF
20.00	SILICON	56.900	64.860	-.34946E+02	.36483E+00	-.32059E-02	0.	0.	0.	0.	1.022
20.00	TISSUE	56.900	64.860	-.20985E+02	.28102E-01	-.61874E-03	0.	0.	0.	0.	.739
20.00	FLUENCE	56.990	63.500	-.36652E+01	.17868E+00	-.21110E-02	0.	0.	0.	0.	
40.00	SILICON	3.008	12.900	-.22578E+02	.25390E+00	.18209E-01	-.14349E+00	0.	0.	0.	.185
40.00	TISSUE	3.008	12.900	-.20025E+02	.23108E+00	.17602E-01	-.13954E+00	0.	0.	0.	.200
40.00	FLUENCE	3.087	12.510	.41988E+00	.52952E+00	.44724E-01	-.32820E+00	0.	0.	0.	
60.00	SILICON	.267	3.404	-.21248E+02	.79842E+01	.11156E+01	-.50897E+01	-.50377E+01	0.	0.	.076
60.00	TISSUE	.267	3.404	-.20089E+02	.29896E+01	.56572E+00	-.23877E+01	-.96914E+00	0.	0.	.066
60.00	FLUENCE	.267	3.404	-.14060E+01	-.34827E+01	.48434E-01	.61945E+00	.46871E+01	0.	0.	
80.00	SILICON	.100	.832	-.22439E+02	-.66020E+00	-.93985E+00	.11795E+01	.51343E+00	0.	0.	.035
80.00	TISSUE	.020	.832	-.20183E+02	.55613E+01	.43925E+01	-.93475E+01	-.38737E+00	0.	0.	.079
80.00	FLUENCE	.020	.832	-.65852E-01	.12961E+02	.13115E+02	-.24948E+02	-.75283E+00	0.	0.	
100.00	SILICON	.026	.289	-.22365E+02	.13079E+02	.29707E+02	-.35520E+02	-.11057E+01	0.	0.	.016
100.00	TISSUE	.026	.289	-.20400E+02	.72731E+01	.33683E+02	-.35283E+02	.19102E+01	0.	0.	.037
100.00	FLUENCE	.015	.226	-.81041E+00	-.15078E+02	.29885E+02	-.14167E+02	.93904E+01	0.	0.	
120.00	SILICON	.015	.153	-.22544E+02	.31382E+01	.37755E+02	-.28172E+02	.16410E+01	0.	0.	.007
120.00	TISSUE	.015	.153	-.20902E+02	-.42039E+02	-.40514E+02	.66353E+02	.11212E+02	0.	0.	.017
120.00	FLUENCE	.015	.153	-.14574E+01	-.90866E+02	-.65230E+02	.13645E+03	.22984E+02	0.	0.	
140.00	SILICON	.015	.114	-.22477E+02	.77458E+01	.50700E+02	-.41709E+02	.90426E+00	0.	0.	.008
140.00	TISSUE	.015	.114	-.20617E+02	-.21028E+02	.18617E+02	.75289E+01	.75787E+01	0.	0.	.009
140.00	FLUENCE	.015	.114	-.13697E+01	-.11692E+03	-.13722E+03	.21346E+03	.25308E+02	0.	0.	

SECONDARY GAMMAS

SAMPLING ALTITUDE (KM)	DOSE	MIN RHOR GM/CM2	MAX RHOR GM/CM2	FIT COEFFICIENTS A	B	C	D	E	F	G	RMS PCT DIFF
20.00	SILICON	56.900	64.860	-.39011E+02	.50399E+00	-.42259E-02	0.	0.	0.	0.	.427
20.00	TISSUE	56.900	64.860	-.50159E+02	.86602E+00	-.72011E-02	0.	0.	0.	0.	.494
20.00	FLUENCE	56.900	64.860	.21116E+02	-.75425E+00	.60706E-02	0.	0.	0.	0.	
40.00	SILICON	3.008	12.900	-.24993E+02	.10285E+01	.51747E-01	-.45729E+00	0.	0.	0.	.346
40.00	TISSUE	3.008	12.900	-.24972E+02	.98591E+00	.49084E-01	-.43680E+00	0.	0.	0.	.348
40.00	FLUENCE	3.008	12.900	-.41507E+01	.11894E+01	.62410E-01	-.53551E+00	0.	0.	0.	
60.00	SILICON	.267	3.404	-.45474E+02	.31996E+02	.22523E+01	-.12401E+02	-.10364E+03	.10329E+03	0.	.137
60.00	TISSUE	.267	3.404	-.44115E+02	.27626E+02	.19945E+01	-.10799E+02	-.92043E+02	.93335E+02	0.	.133
60.00	FLUENCE	.267	3.404	-.26118E+02	.33070E+02	.23177E+01	-.12671E+02	-.11040E+03	.11078E+03	0.	
80.00	SILICON	.020	.832	-.31936E+02	-.96053E+02	-.26385E+02	.80890E+02	.56267E+02	-.74238E+01	0.	.060
80.00	TISSUE	.020	.832	-.31900E+02	-.95895E+02	-.26076E+02	.80357E+02	.56780E+02	-.79054E+01	0.	.059
80.00	FLUENCE	.020	.832	-.15214E+02	-.15262E+02	.42820E+00	.99568E+01	-.32578E+02	.49167E+02	0.	
100.00	SILICON	.015	.289	-.36476E+02	-.12482E+03	-.13574E+03	.22720E+03	-.35236E+02	.65207E+02	0.	.089
100.00	TISSUE	.015	.289	-.36705E+02	-.11179E+03	-.12430E+03	.20820E+03	-.43202E+02	.69332E+02	0.	.090
100.00	FLUENCE	.015	.289	-.17149E+02	-.40007E+02	-.47799E+02	.96064E+02	-.91624E+02	.95865E+02	0.	
120.00	SILICON	.015	.153	-.53629E+02	.60165E+03	.31381E+03	-.64154E+03	-.60511E+03	.38323E+03	0.	.062
120.00	TISSUE	.015	.153	-.54207E+02	.64911E+03	.38219E+03	-.72856E+03	-.62946E+03	.39526E+03	0.	.064
120.00	FLUENCE	.015	.153	-.41869E+02	.12460E+04	.11574E+04	-.17528E+04	-.97200E+03	.57147E+03	0.	
140.00	SILICON	.015	.114	-.10454E+03	.40752E+04	.46770E+04	-.64860E+04	-.26159E+04	.14183E+04	0.	.002
140.00	TISSUE	.015	.114	-.10379E+03	.40358E+04	.46433E+04	-.64310E+04	-.25891E+04	.14039E+04	0.	.003
140.00	FLUENCE	.015	.114	-.75309E+02	.36165E+04	.42308E+04	-.57965E+04	-.23279E+04	.12654E+04	0.	

APPENDIX C

MORSAIR SILICON DOSES AND K-FACTORS

For each of the 15 MORSAIR runs, this appendix contains the computer plotted results of:

1. The fit of the MORSAIR $4\pi R^2$ silicon dose versus the mass range ("RHOR" in the figures). The different point symbols were calculated from the fits to the MORSAIR data, and the solid line is the fit of the one-dimensional ANISN data.

2. The silicon dose K-factors as a function of mass range at each sampling altitude.

In order to reduce the number of plots, several sampling altitudes have been combined on a single figure.

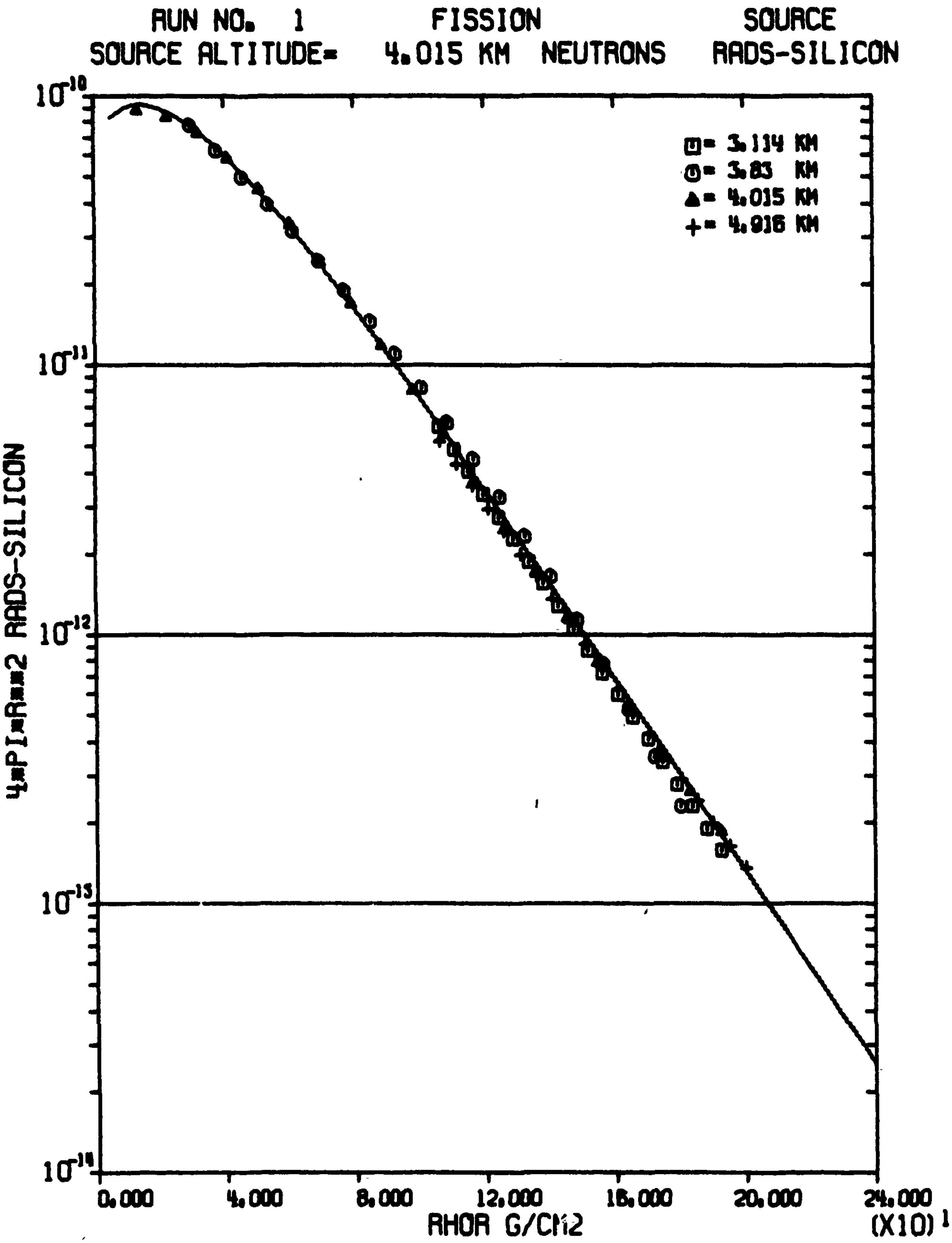


FIGURE C- 1 MORSAIR FIT DATA-4PIR**2 NEUTRON SI DOSE,
FISSION SOURCE IN HOMO AIR AT 4.0 KM.
ALL SAMPLING ALTITUDES

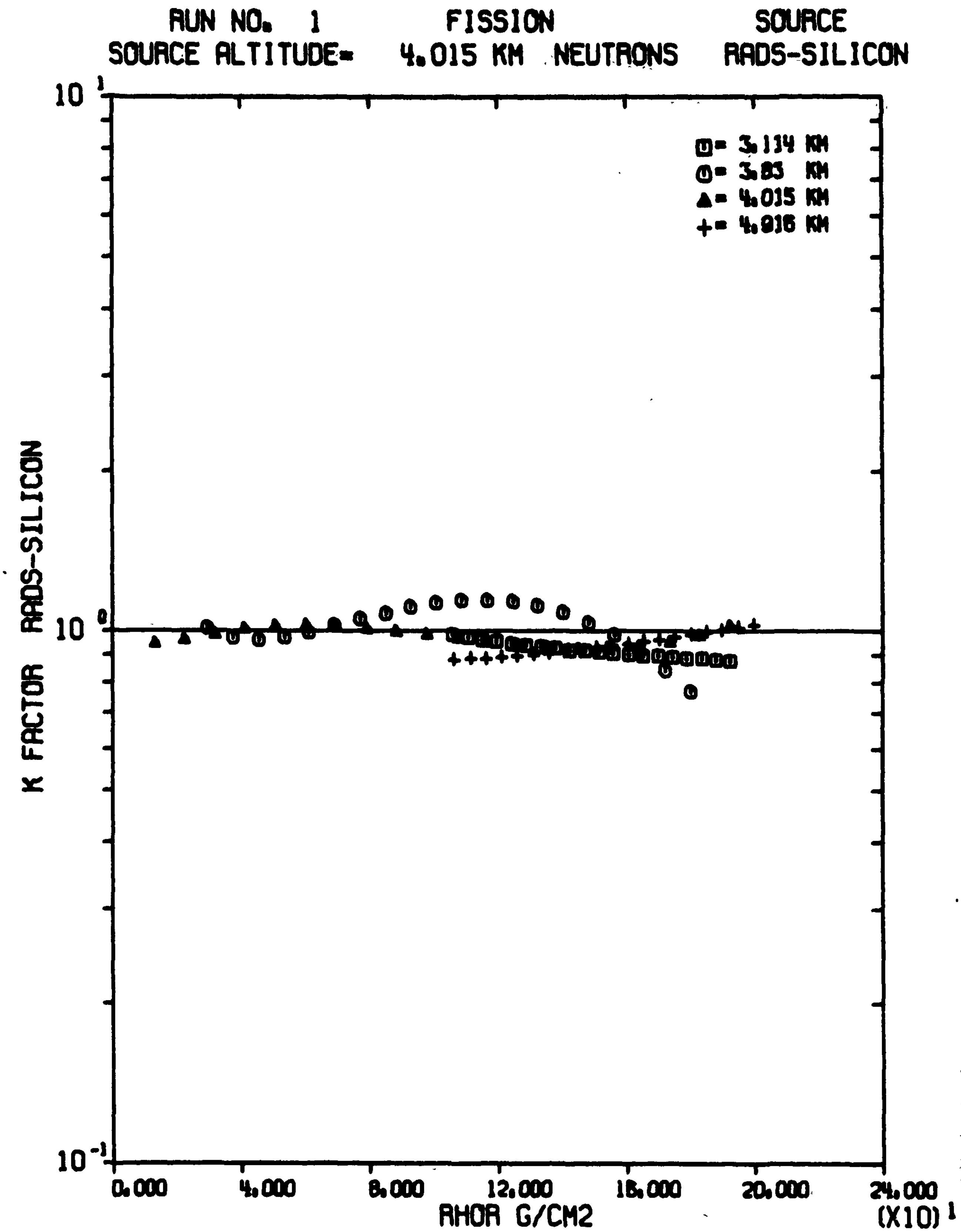


FIGURE C-2 MORSAIR FIT DATA-NEUTRON SILICON K-FACTOR
FISSION SOURCE IN HOMO AIR AT 4.0 KM.
ALL SAMPLING ALTITUDES

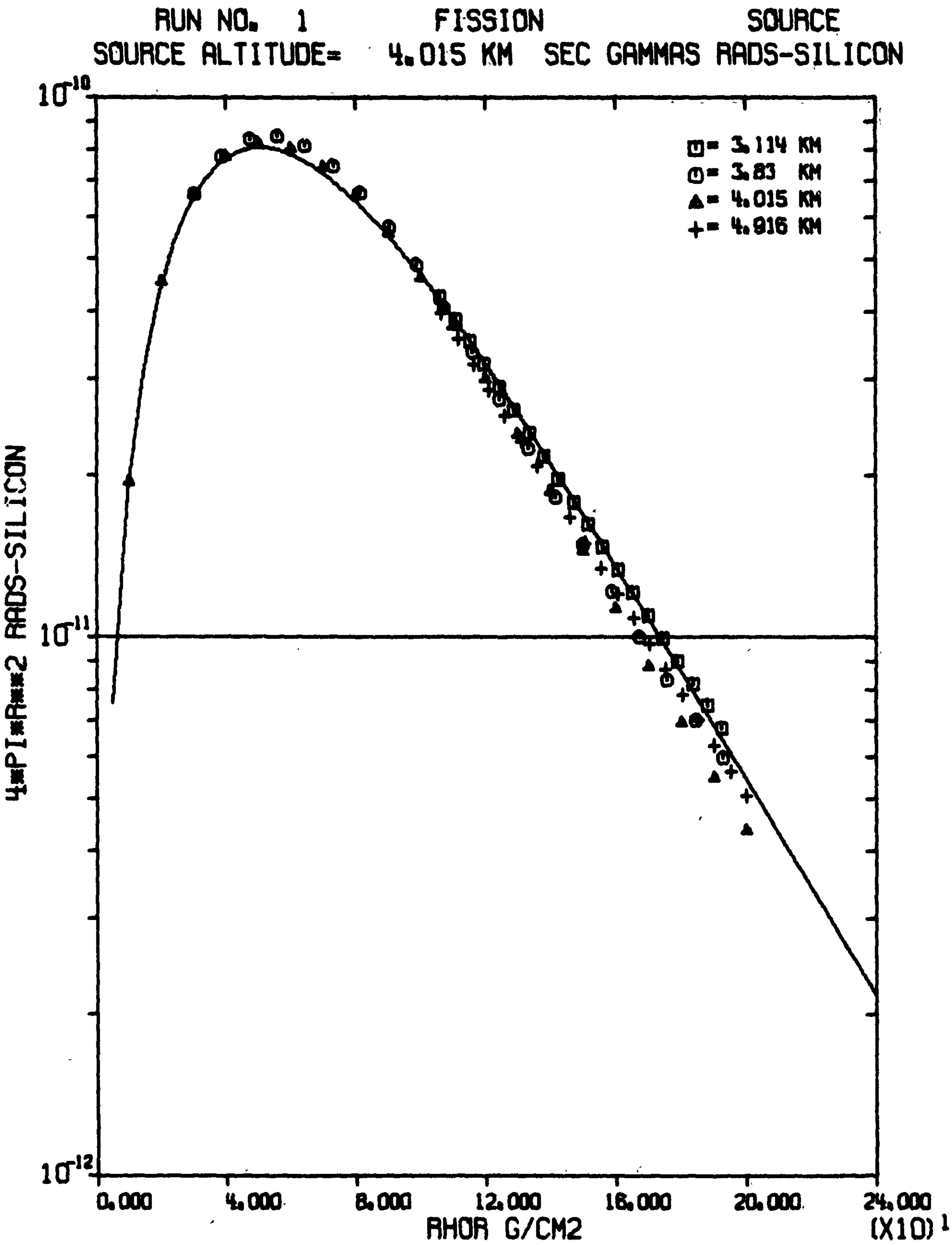


FIGURE 3- 3 MORSAIR FIT DATA-4PIR**2 GAMMA SI DOSE,
FISSION SOURCE IN HOMO AIR AT 4.0 KM.
ALL SAMPLING ALTITUDES

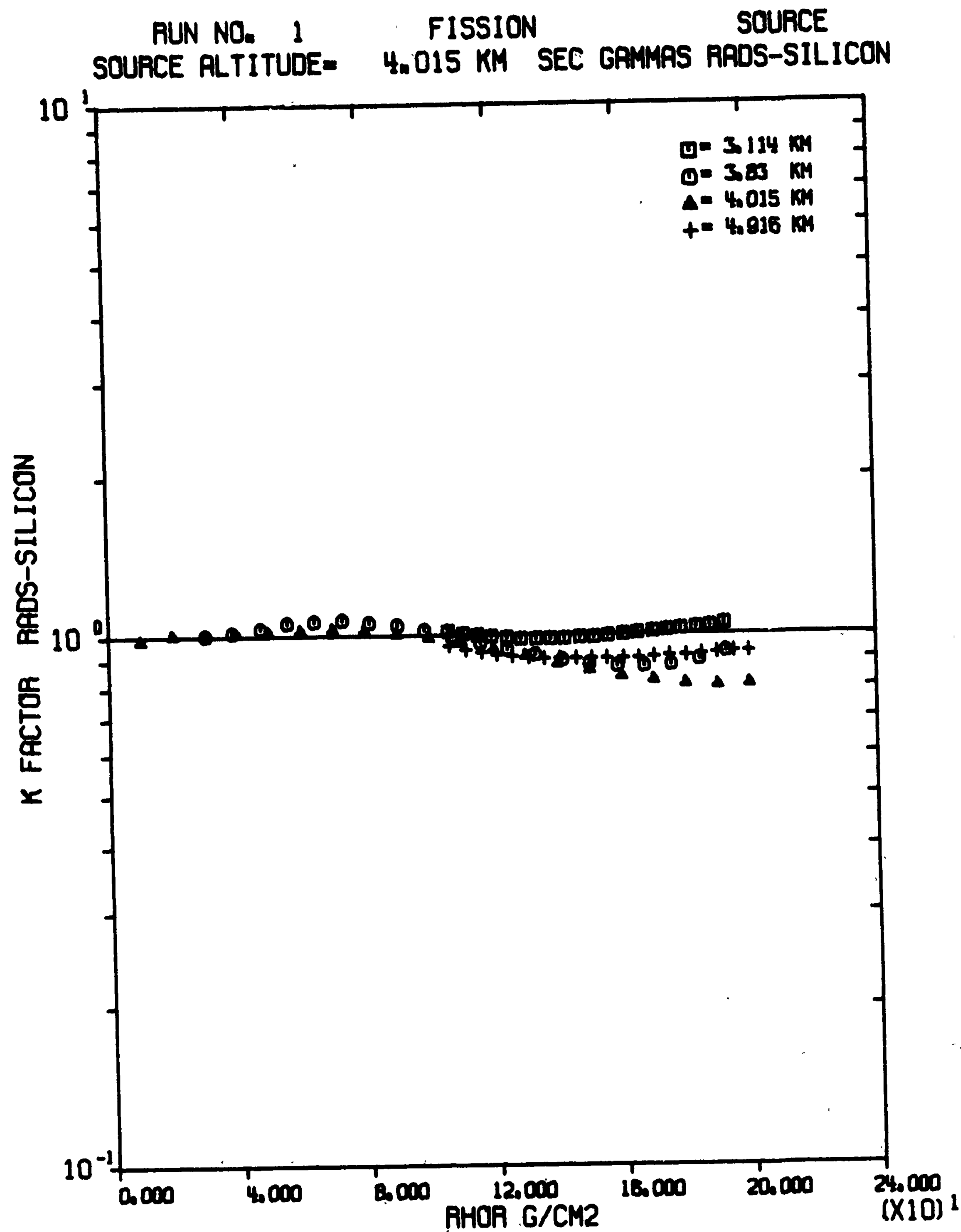


FIGURE C- 4 MORSAIR FIT DATA-GAMMA SILICON K-FACTOR,
FISSION SOURCE IN HOMO AIR AT 4.0 KM.
ALL SAMPLING ALTITUDES

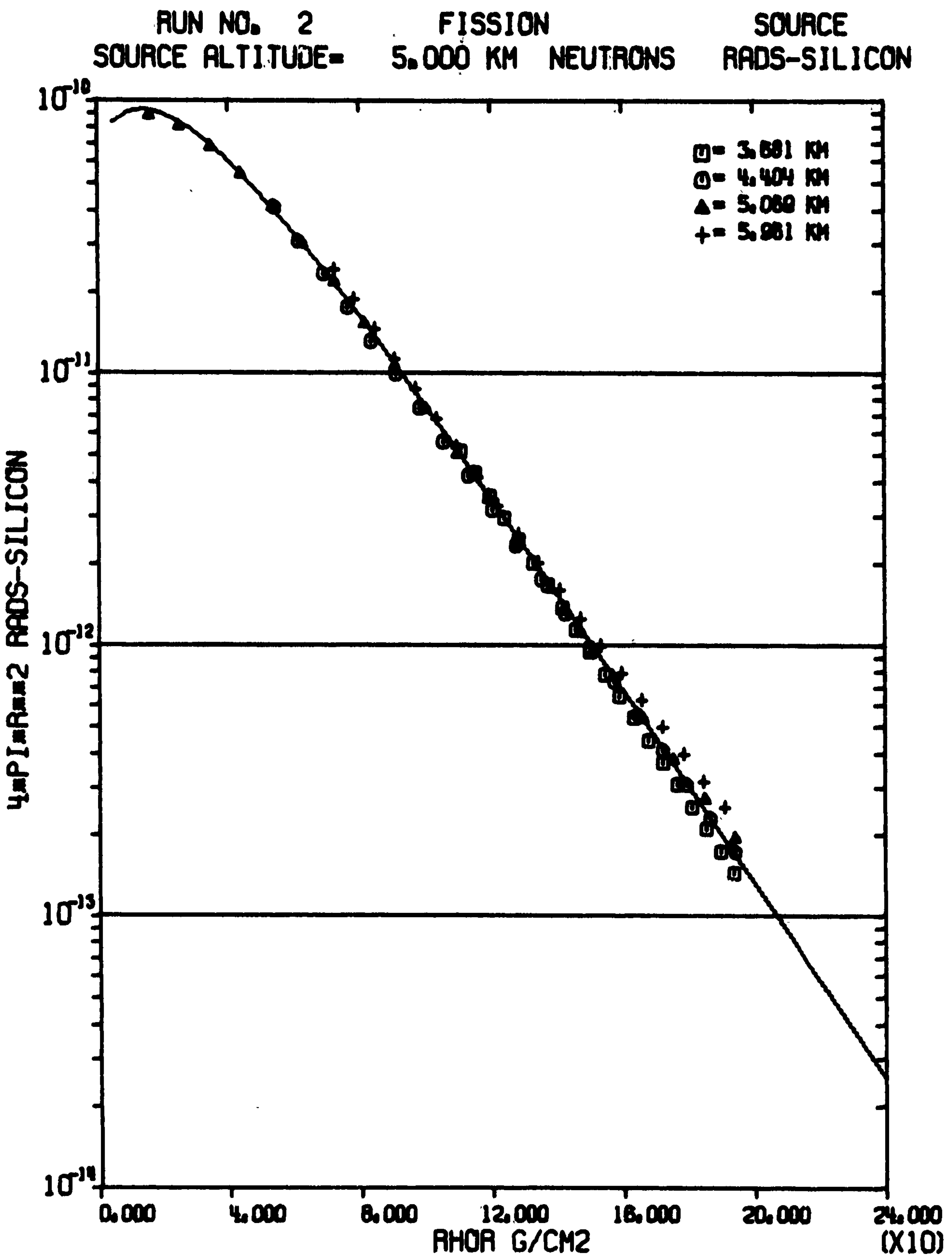


FIGURE C- 5 MORSAIR FIT DATA-4PIR**2 NEUTRON SI DOSE,
FISSION SOURCE IN REAL AIR AT 5.0 KM.
ALL SAMPLING ALTITUDES

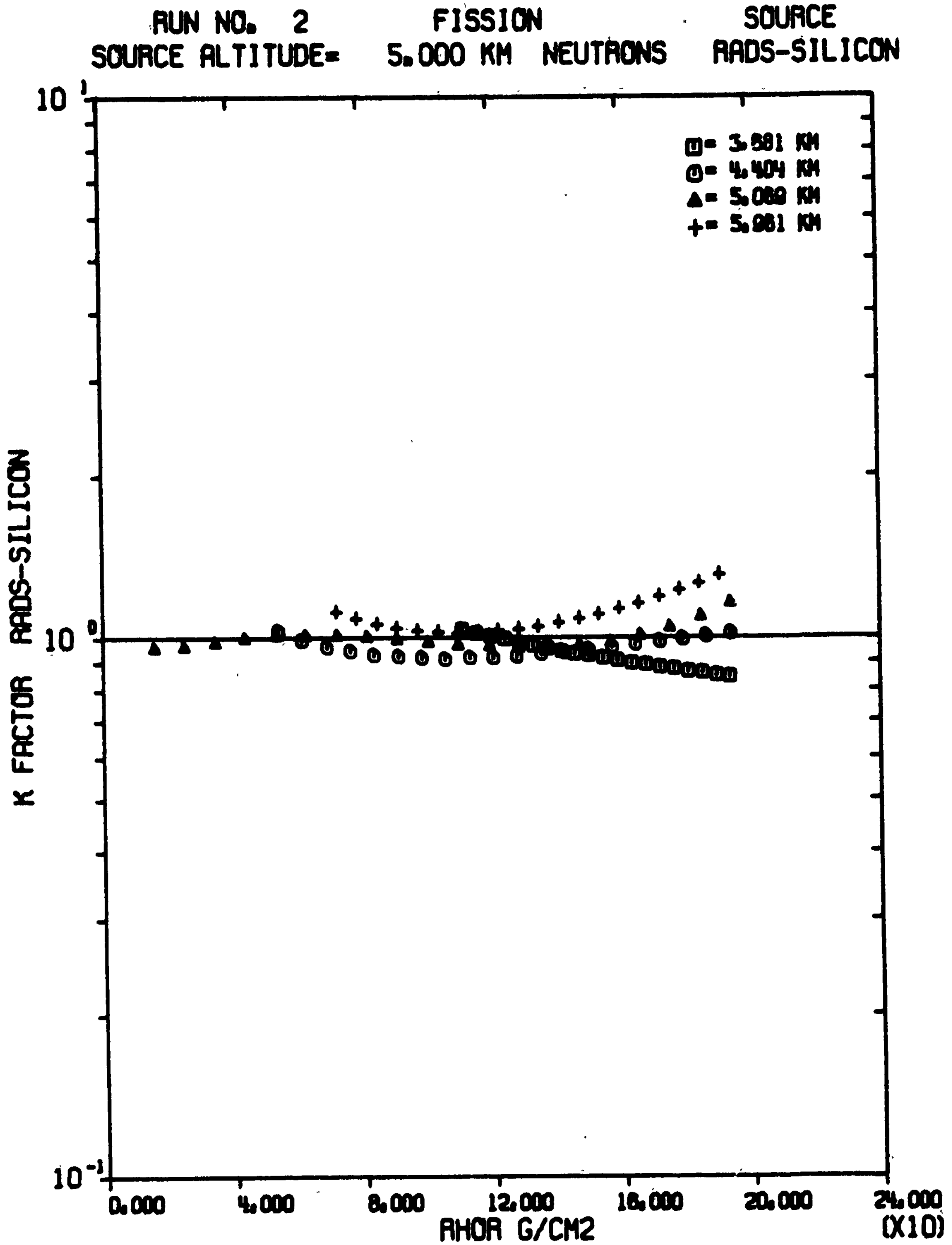


FIGURE C- 6 MORSAIR FIT DATA-NEUTRON SILICON K-FACTOR FISSION SOURCE IN REAL AIR AT 5.0 KM. ALL SAMPLING ALTITUDES

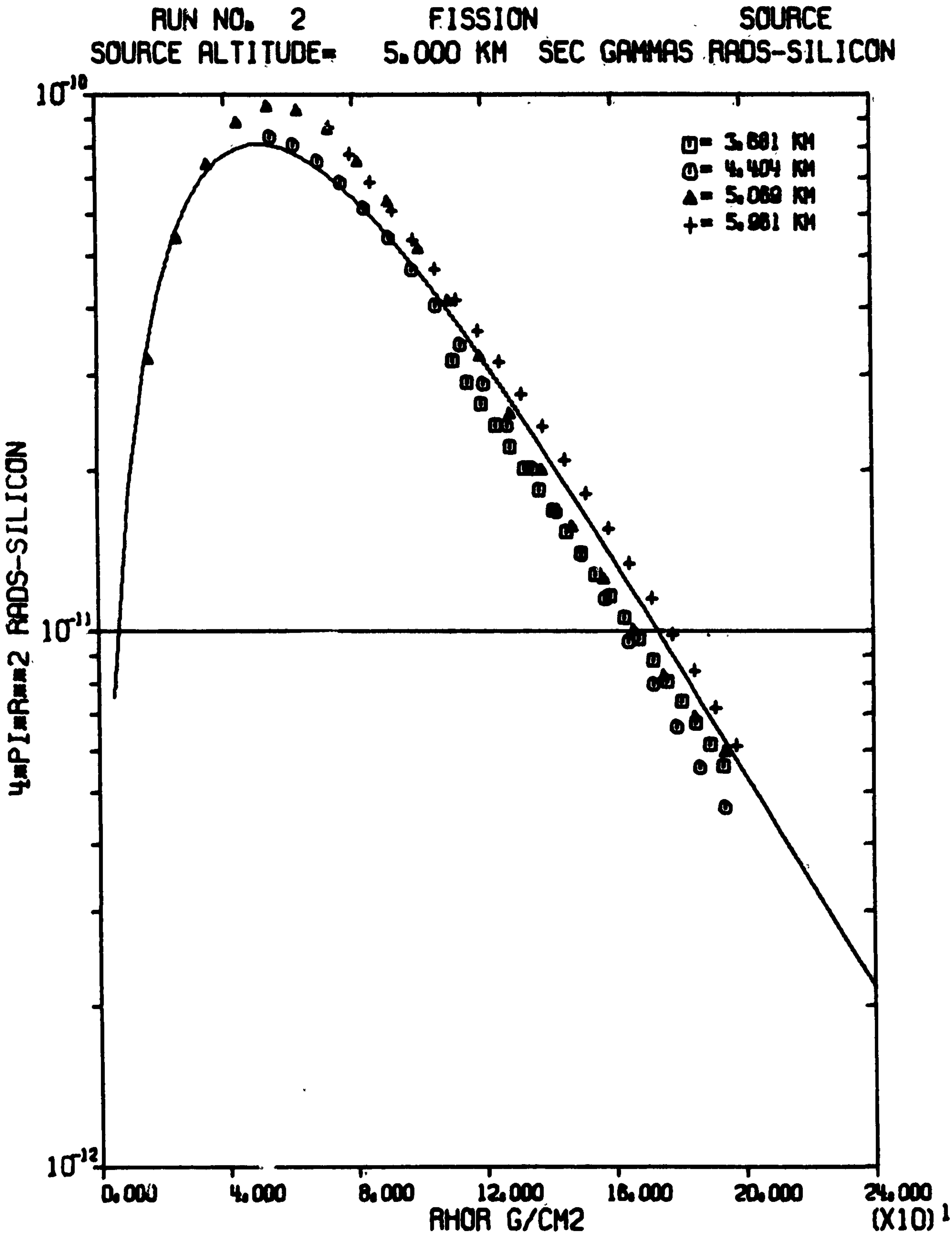


FIGURE C- 7 MORSAIR FIT DATA-4PIR**2 GAMMA SI DOSE,
FISSION SOURCE IN REAL AIR AT 5.0 KM.
ALL SAMPLING ALTITUDES

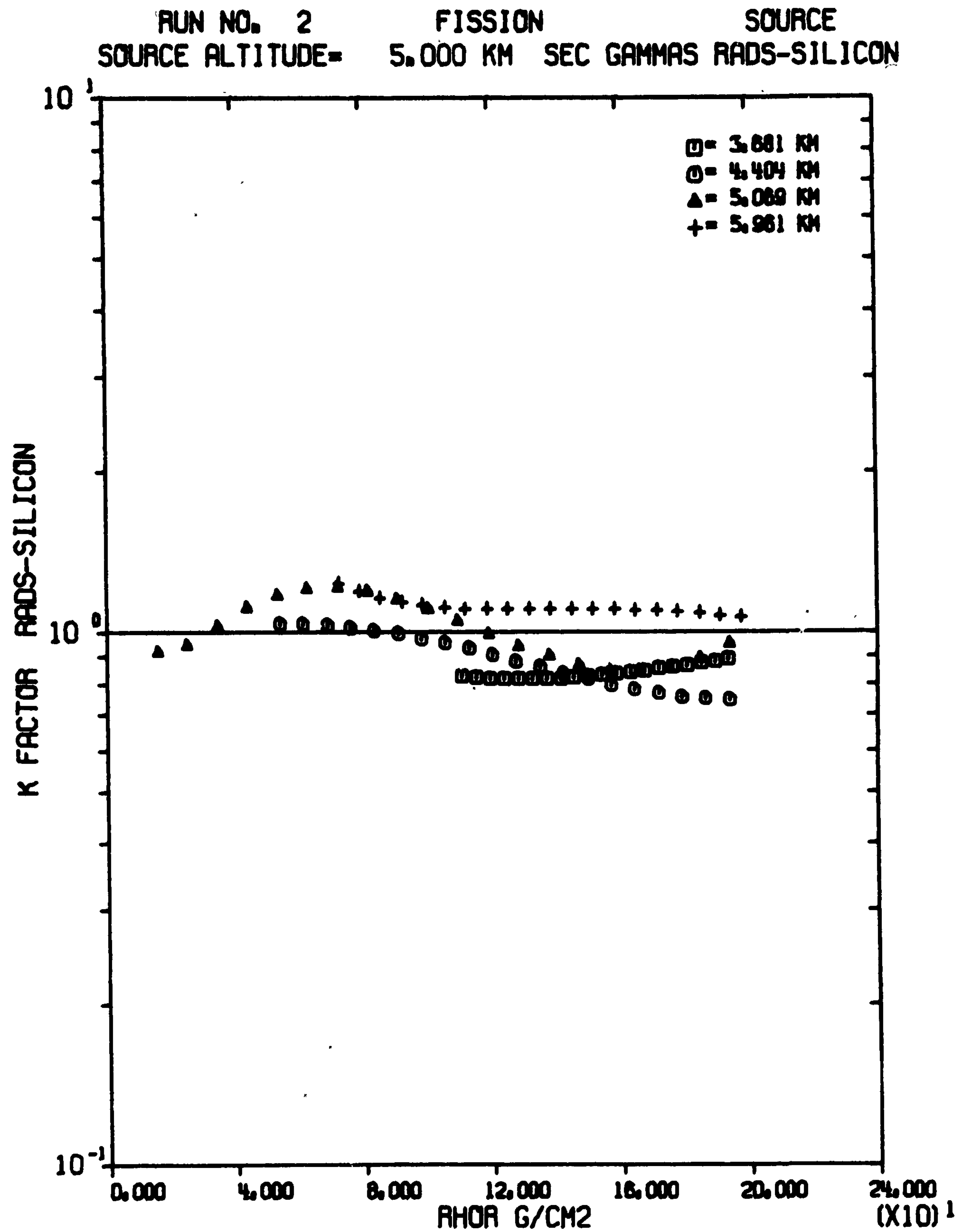


FIGURE C- 6 MORSAIR FIT DATA-GAMMA SILICON K-FACTOR, FISSION SOURCE IN REAL AIR AT 5.0 KM. ALL SAMPLING ALTITUDES

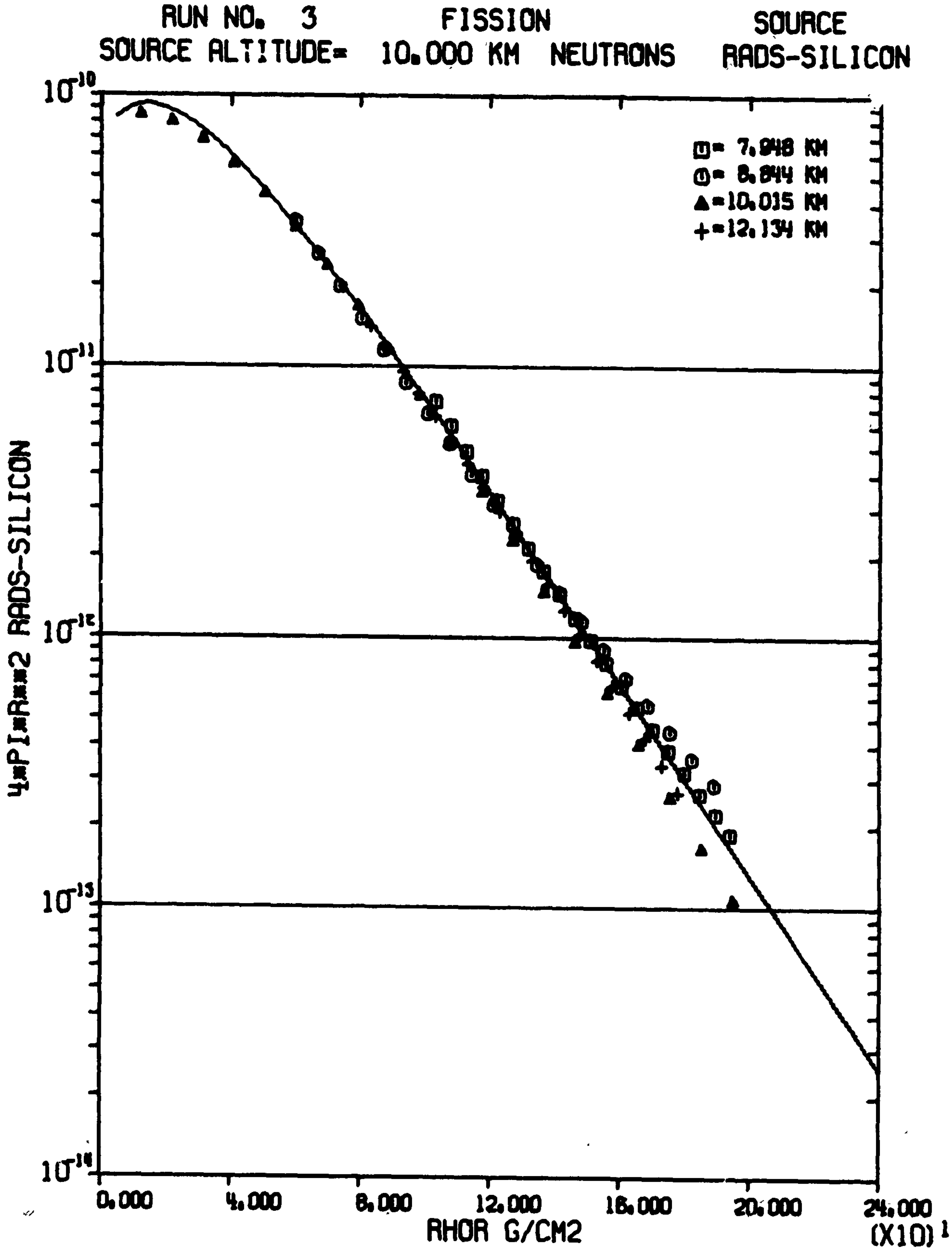


FIGURE C- 9 MORSAIR FIT DATA-4PIR**2 NEUTRON SI DOSE, FISSION SOURCE IN REAL AIR AT 10.0 KM. ALL SAMPLING ALTITUDES

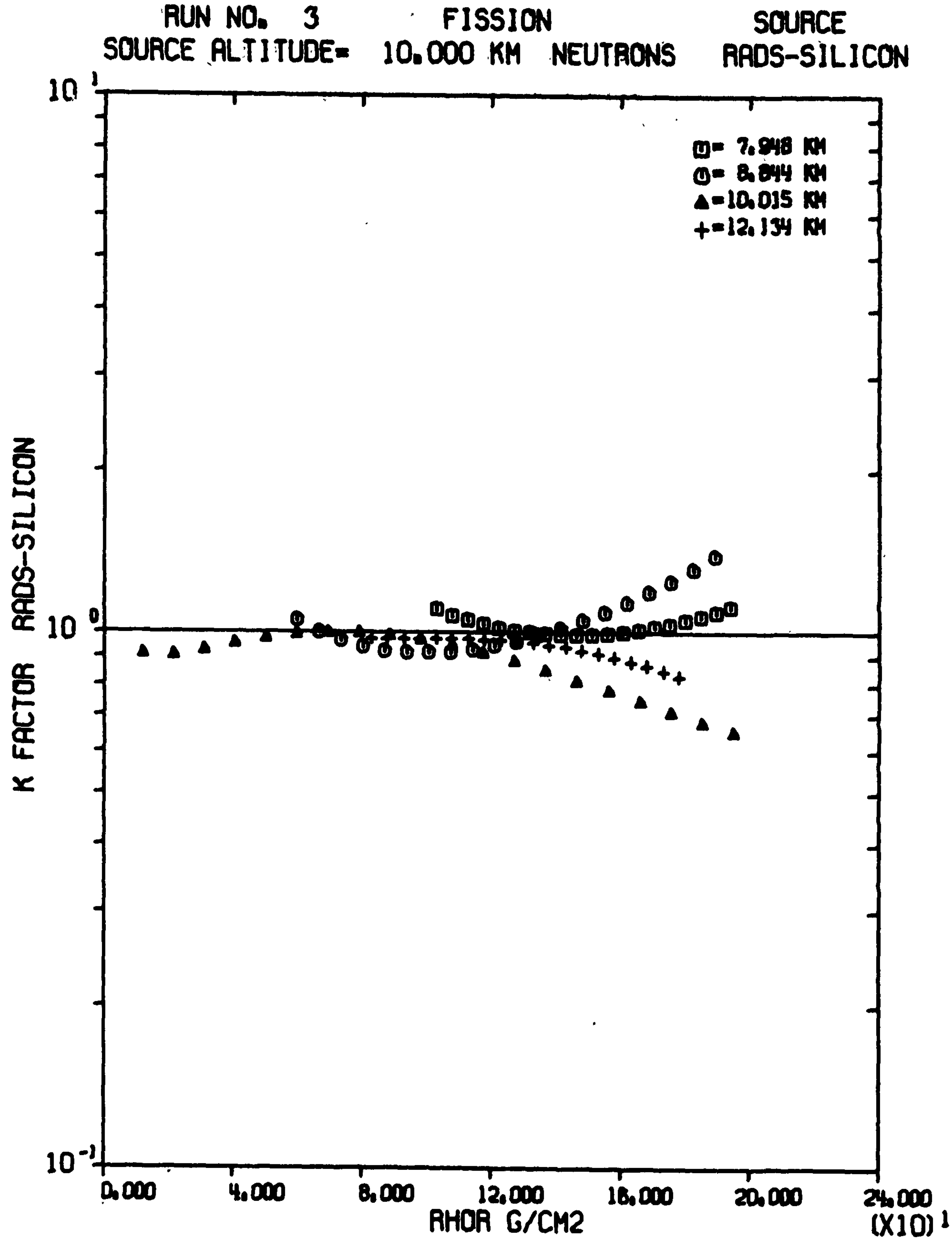


FIGURE C-10 NORSAIR FIT DATA-NEUTRON SILICON K-FACTOR
FISSION SOURCE IN REAL AIR AT 10.0 KM.
ALL SAMPLING ALTITUDES

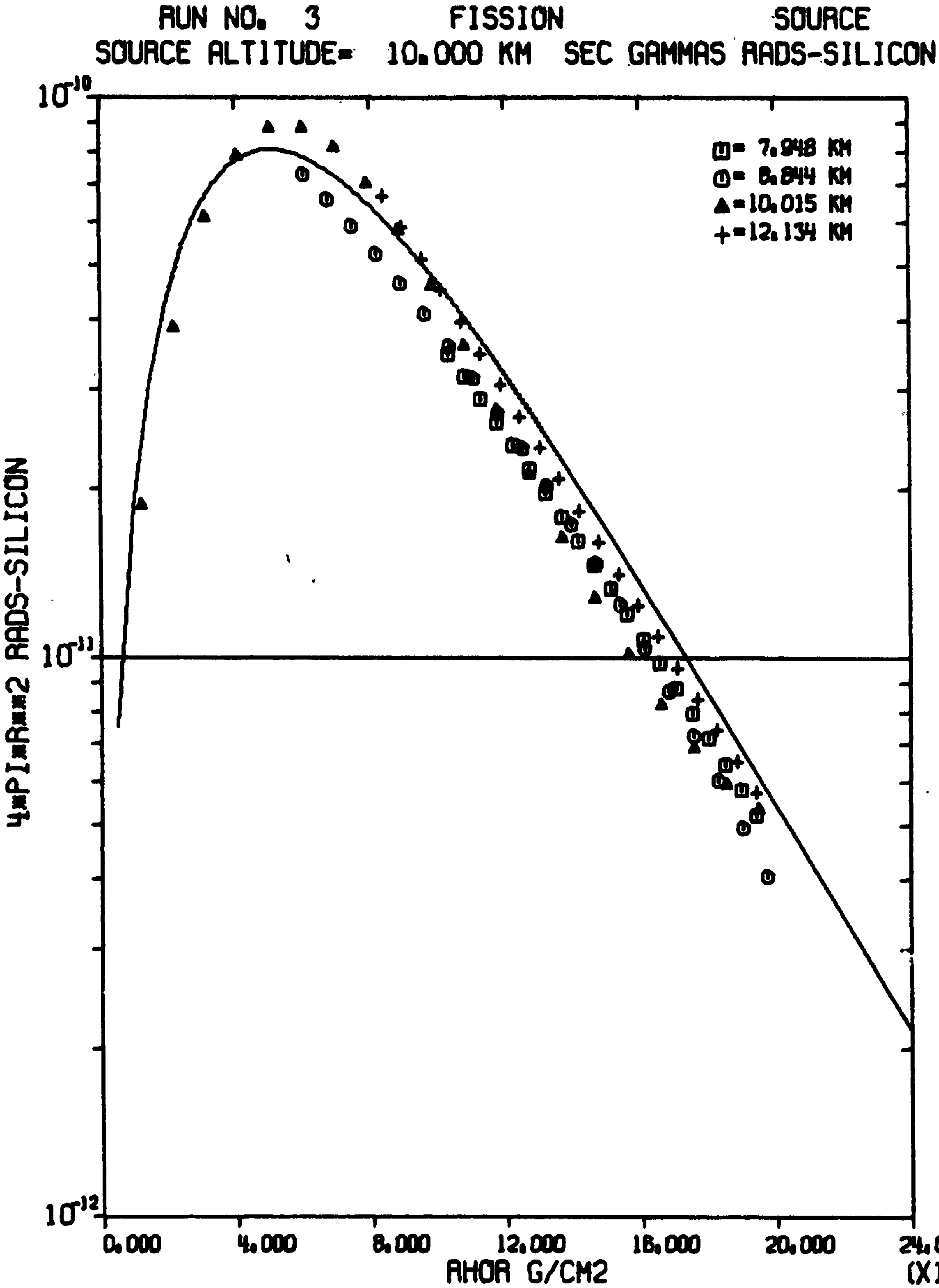


FIGURE C-11 MORSAIR FIT DATA-4PIR**2 GAMMA SI DOSE, FISSION SOURCE IN REAL AIR AT 10.0 KM. ALL SAMPLING ALTITUDES

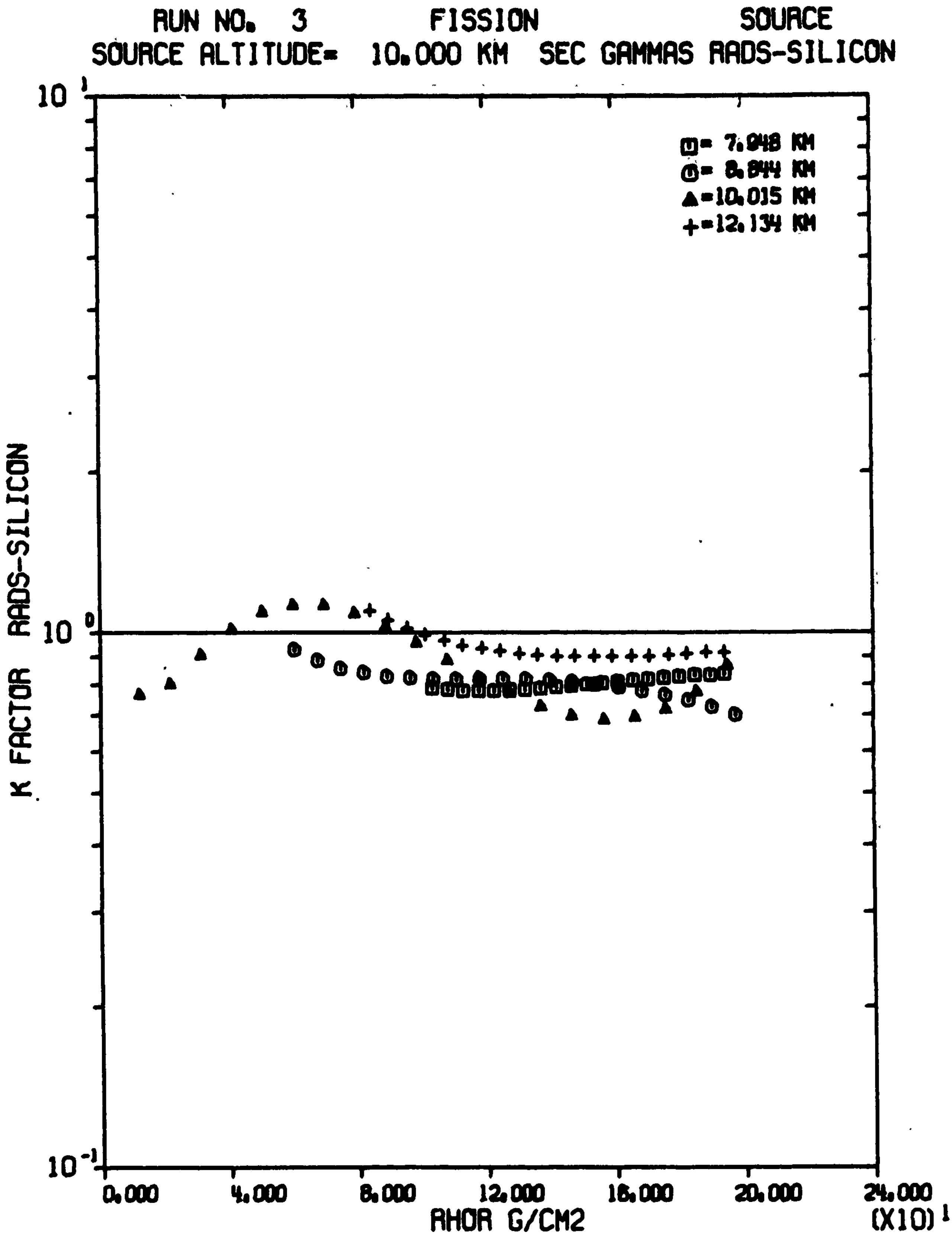


FIGURE C-12 MORSAIR FIT DATA-GAMMA SILICON K-FACTOR, FISSION SOURCE IN REAL AIR AT 10.0 KM. ALL SAMPLING ALTITUDES

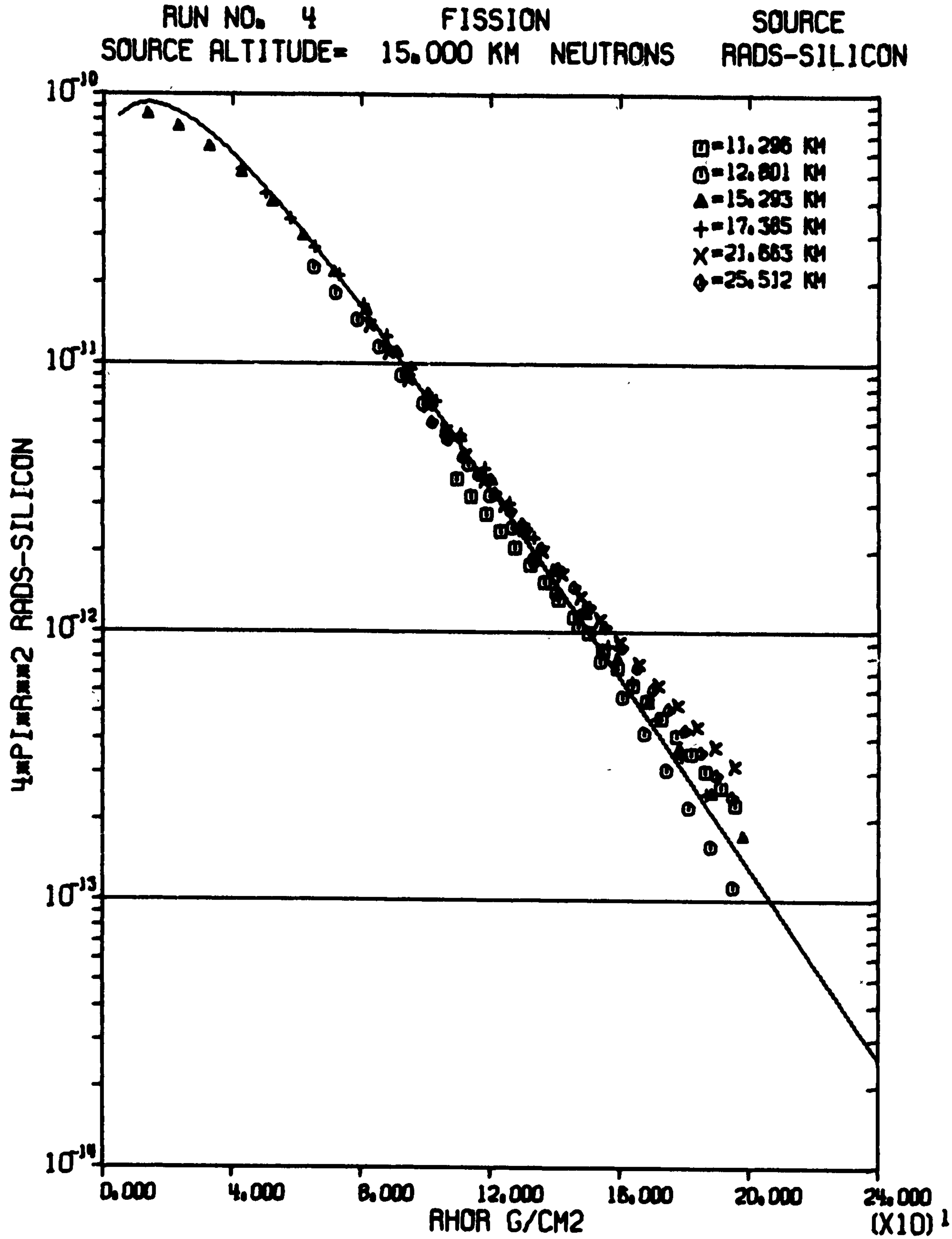


FIGURE C-13 NORSAIR FIT DATA-4PIR**2 NEUTRON SI DOSE, FISSION SOURCE IN REAL AIR AT 15.0 KM. ALL SAMPLING ALTITUDES

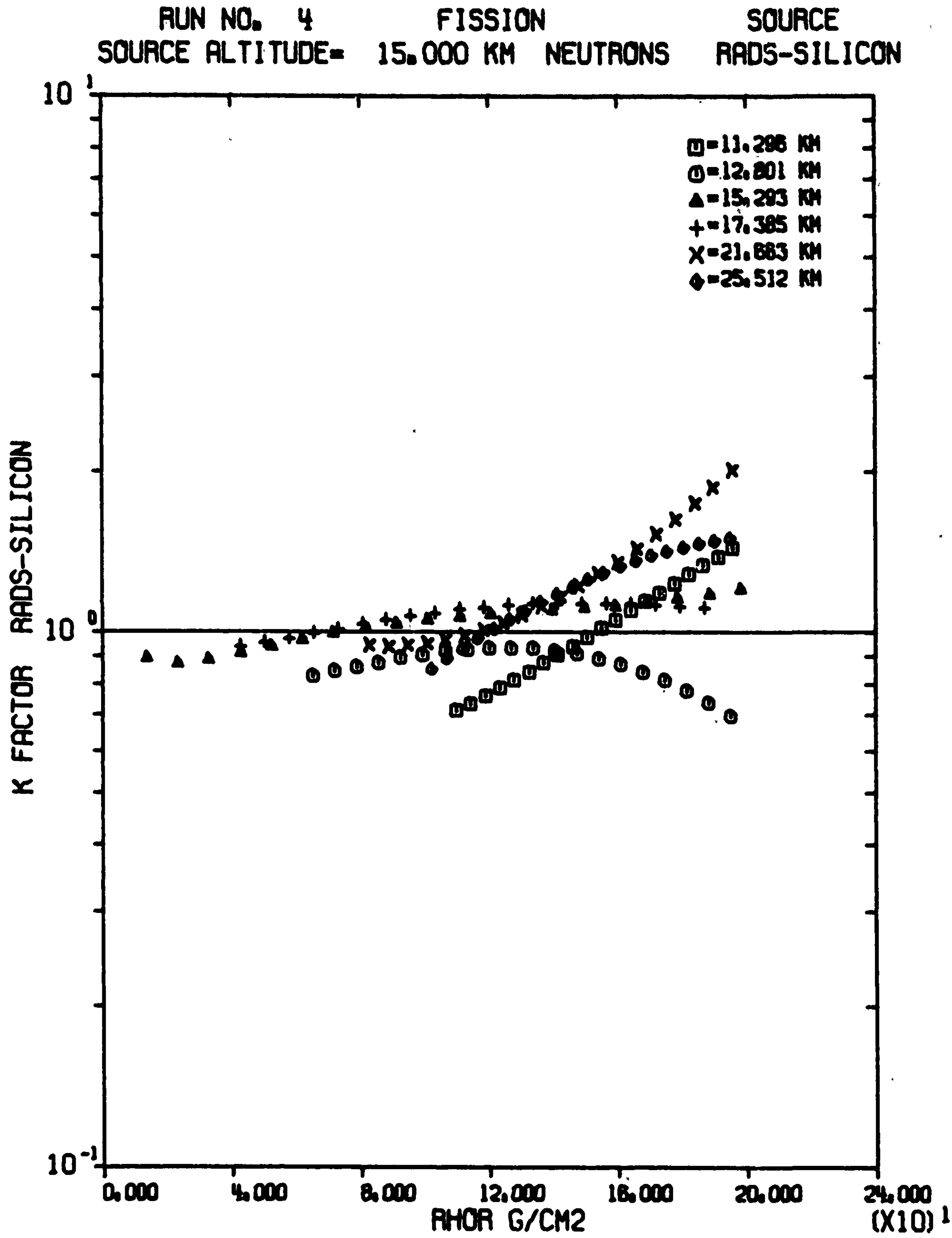


FIGURE C-14 MORSAIR FIT DATA-NEUTRON SILICON K-FACTOR
FISSION SOURCE IN REAL AIR AT 15.0 KM.
ALL SAMPLING ALTITUDES

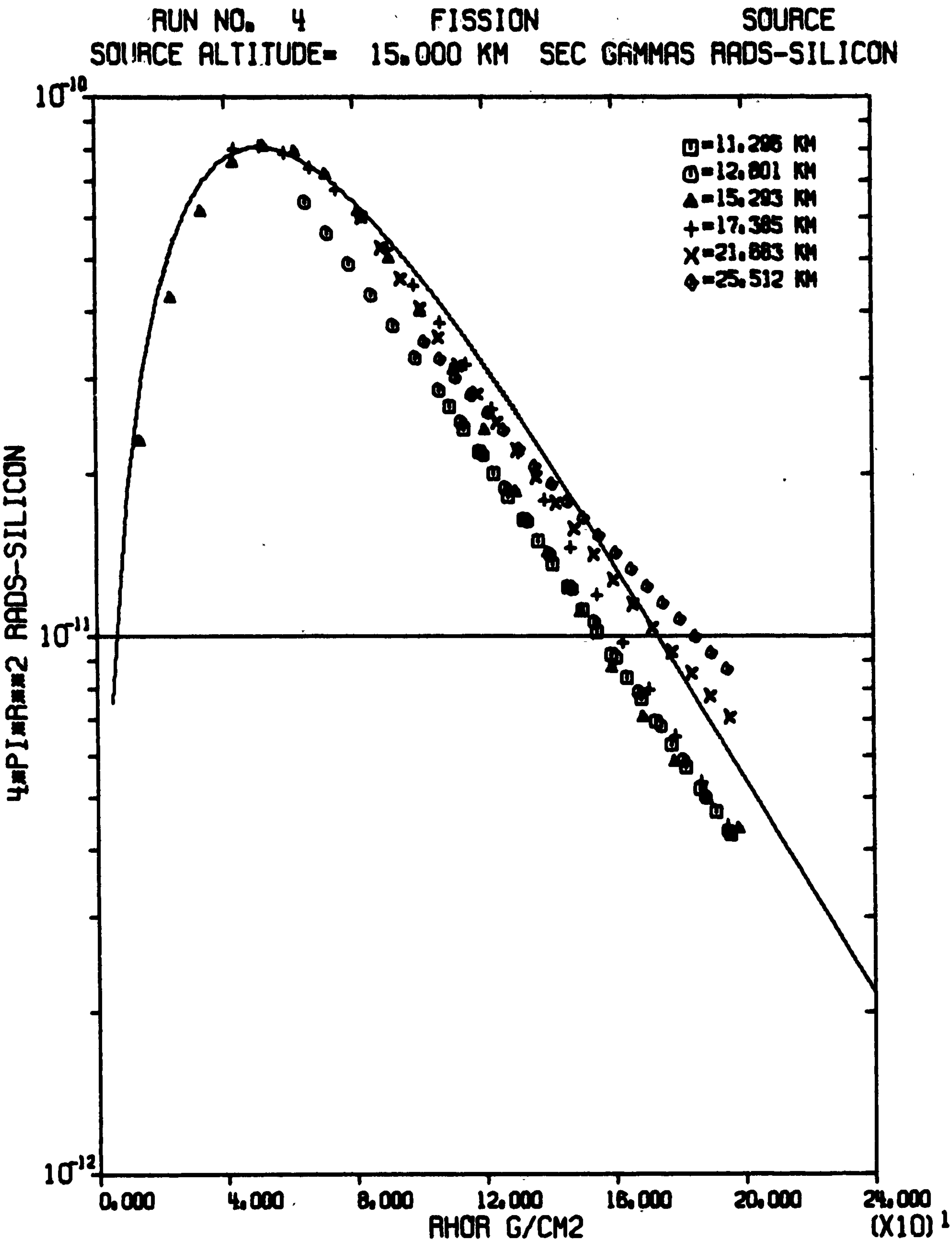


FIGURE C-15 MORSAIR FIT DATA-4PIR**2 GAMMA SI DOSE,
FISSION SOURCE IN REAL AIR AT 15.0 KM.
ALL SAMPLING ALTITUDES

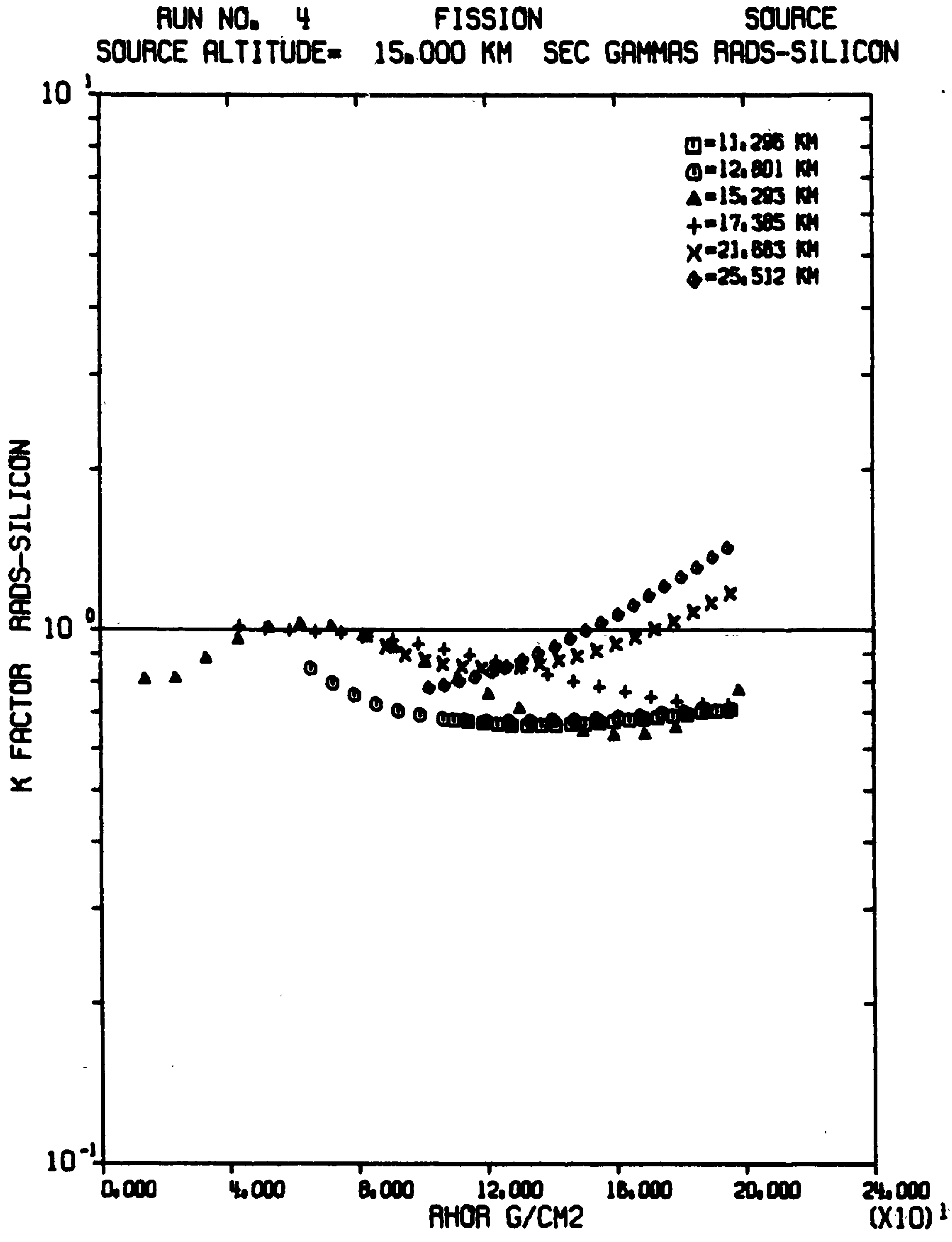


FIGURE C-16 MORSAIR FIT DATA-GAMMA SILICON K-FACTOR, FISSION SOURCE IN REAL AIR AT 15.0 KM. ALL SAMPLING ALTITUDES

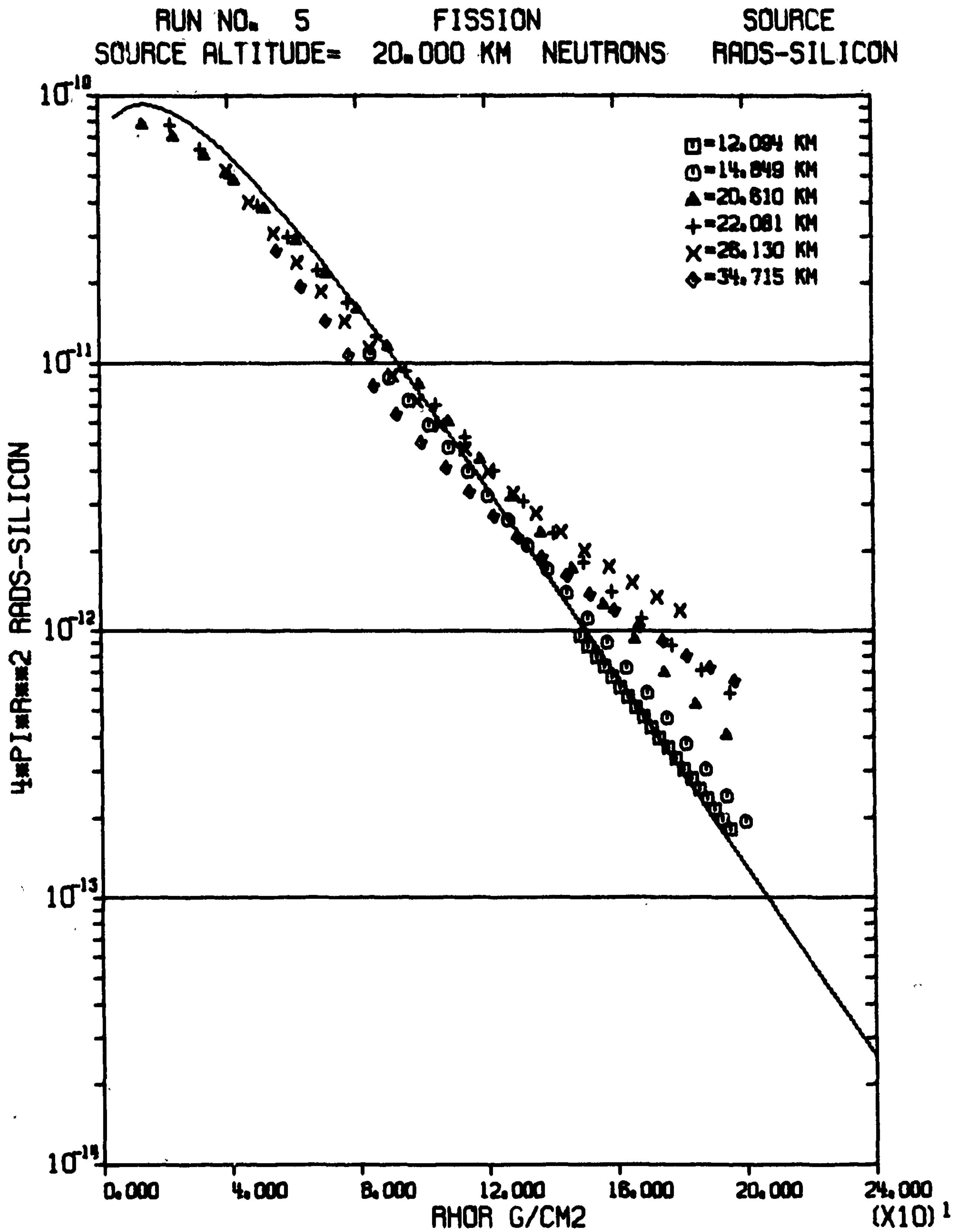


FIGURE C-17 MORSAIR FIT DATA-4PIR**2 NEUTRON SI DOSE, FISSION SOURCE IN REAL AIR AT 20.0 KM. ALL SAMPLING ALTITUDES

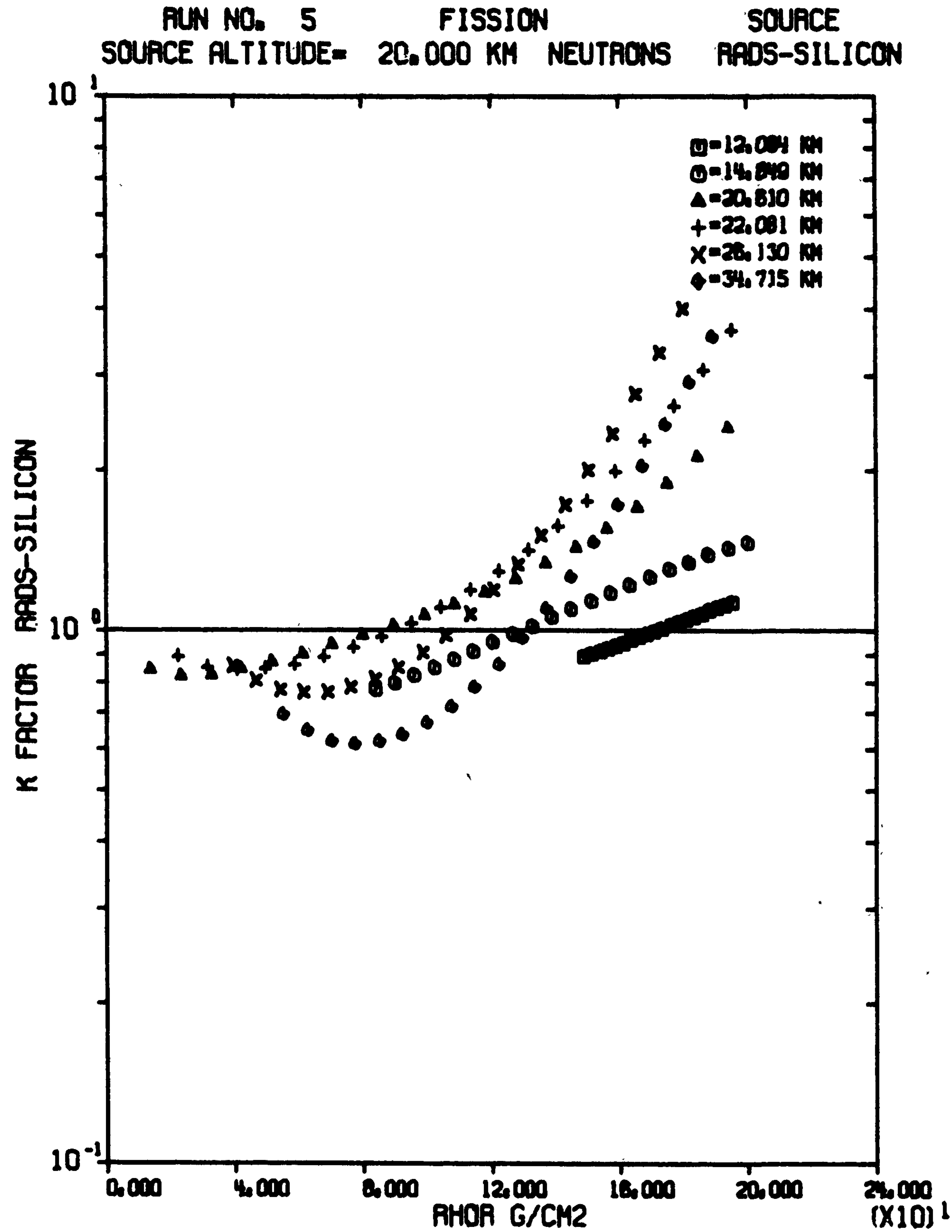


FIGURE C-18 NORSAIR FIT DATA-NEUTRON SILICON K-FACTOR
FISSION SOURCE IN REAL AIR AT 20.0 KM.
ALL SAMPLING ALTITUDES

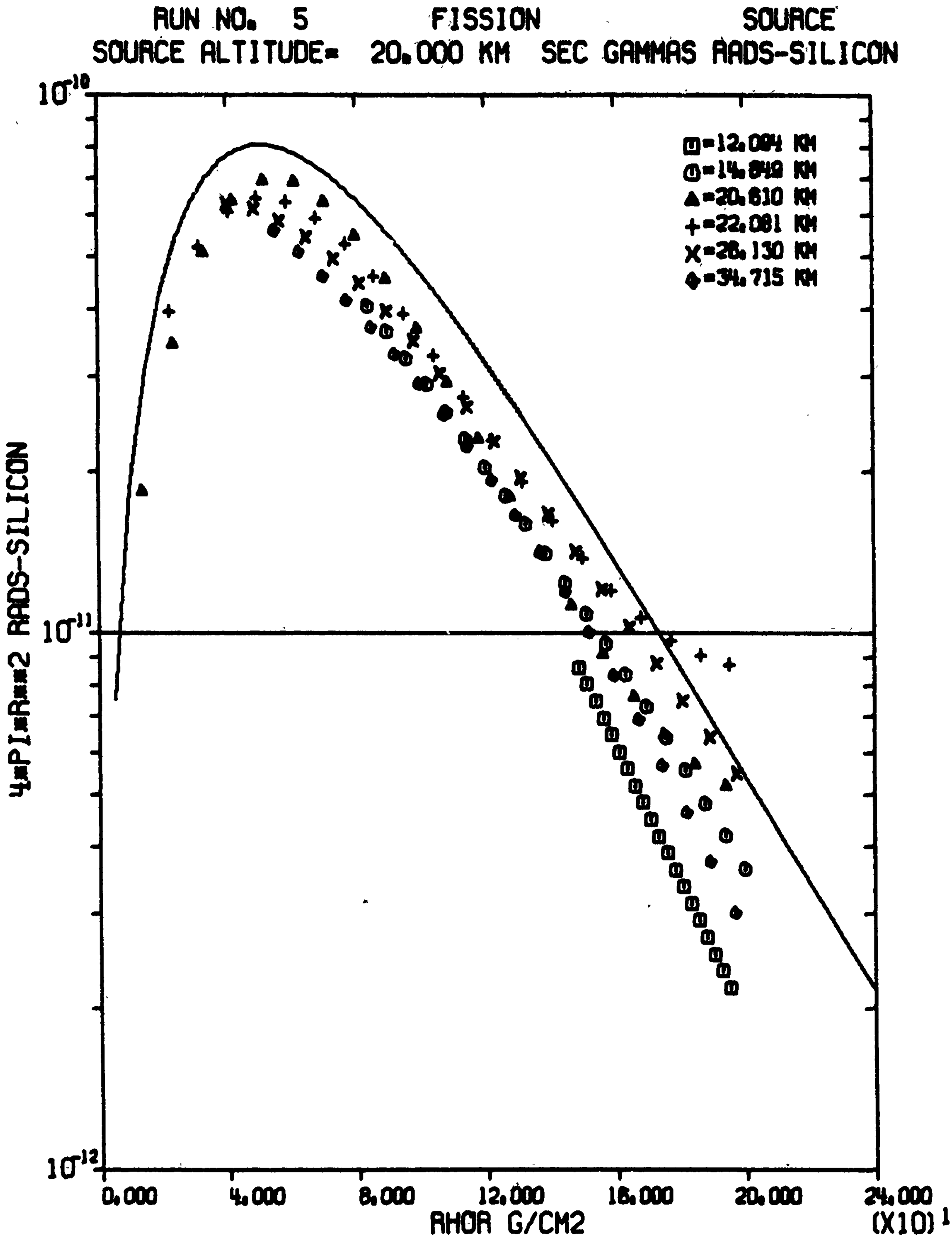


FIGURE C-19 HORSAIR FIT DATA-4PIR**2 GAMMA SI DOSE,
FISSION SOURCE IN REAL AIR AT 20.0 KM.
ALL SAMPLING ALTITUDES

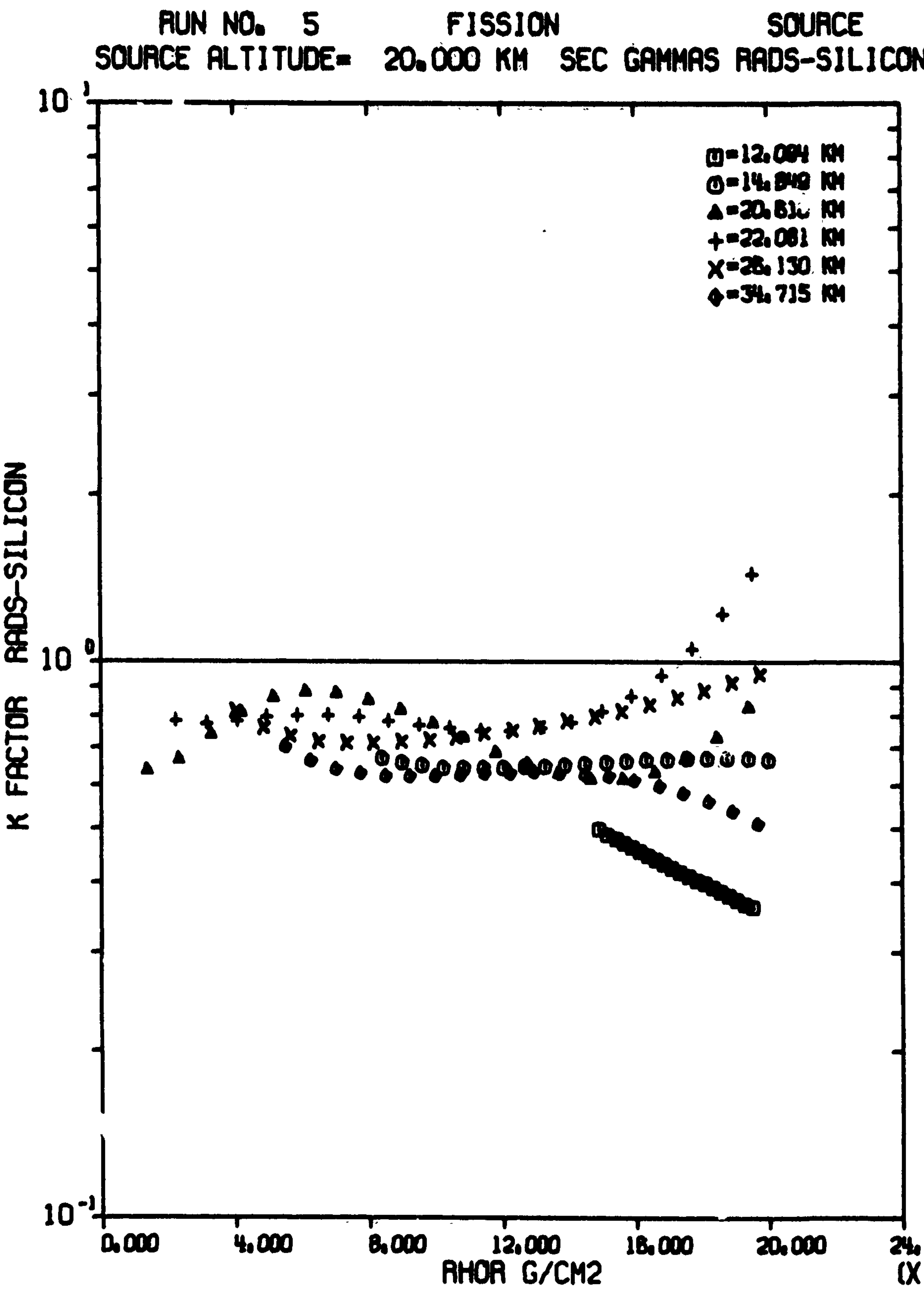


FIGURE C-20 NORSAIR FIT DATA-GAMMA SILICON K-FACTOR, FISSION SOURCE IN REAL AIR AT 20.0 KM. ALL SAMPLING ALTITUDES

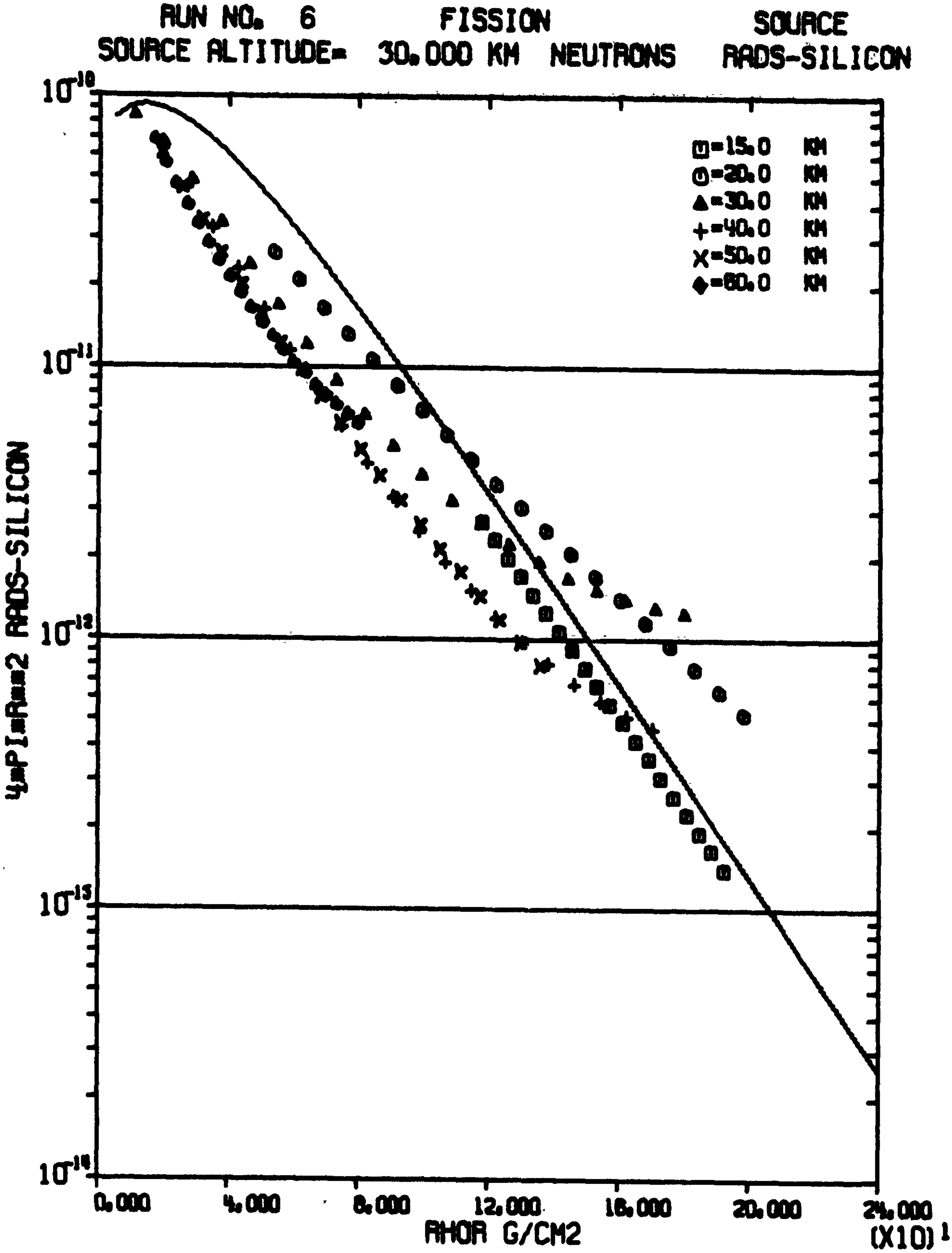


FIGURE C-21 MORSAIR FIT DATA-4PIR**2 NEUTRON SI DOSE, FISSION SOURCE IN REAL AIR AT 30.0 KM. ALL SAMPLING ALTITUDES

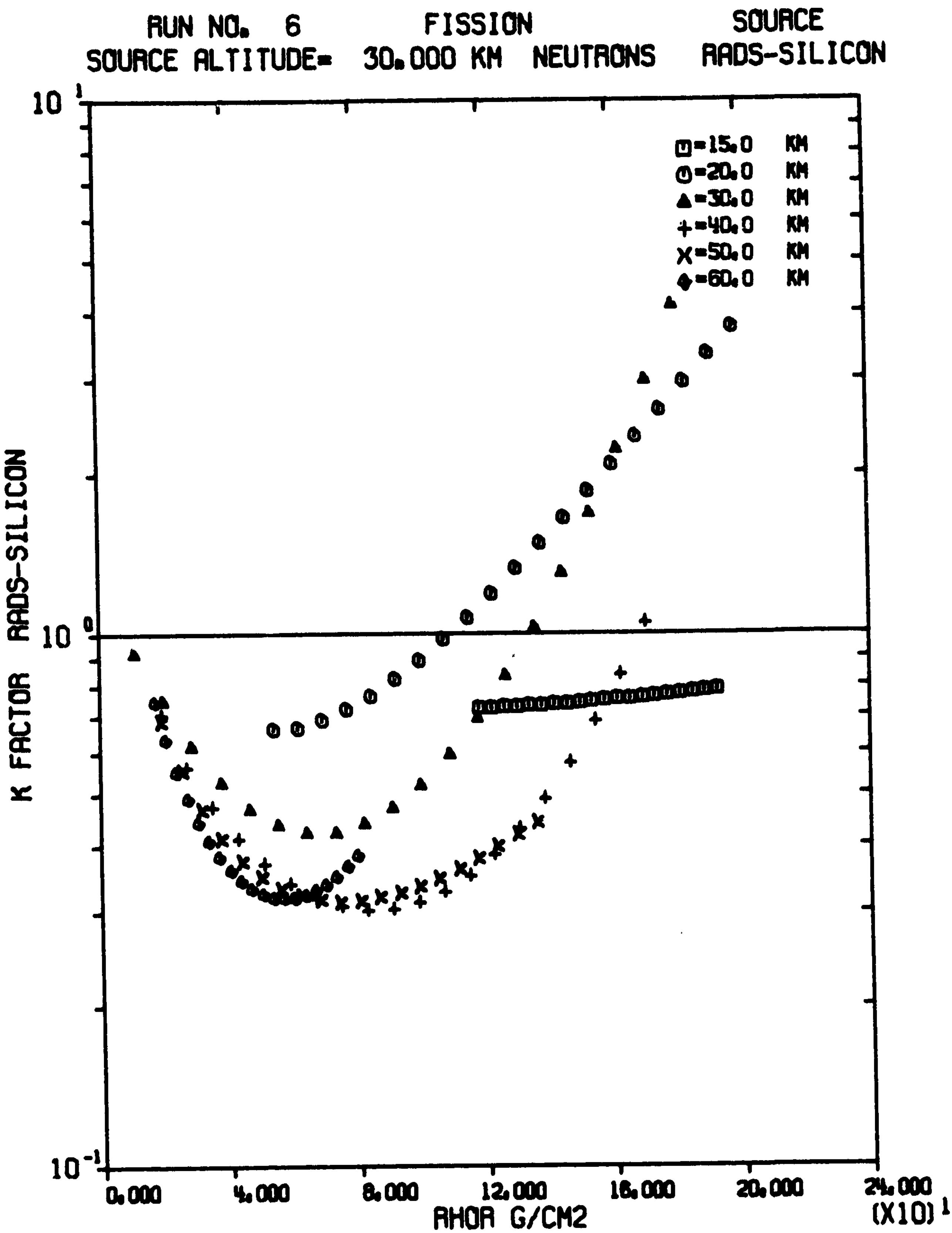


FIGURE C-22 MORSAIR FIT DATA-NEUTRON SILICON K-FACTOR
FISSION SOURCE IN REAL AIR AT 30.0 KM.
ALL SAMPLING ALTITUDES

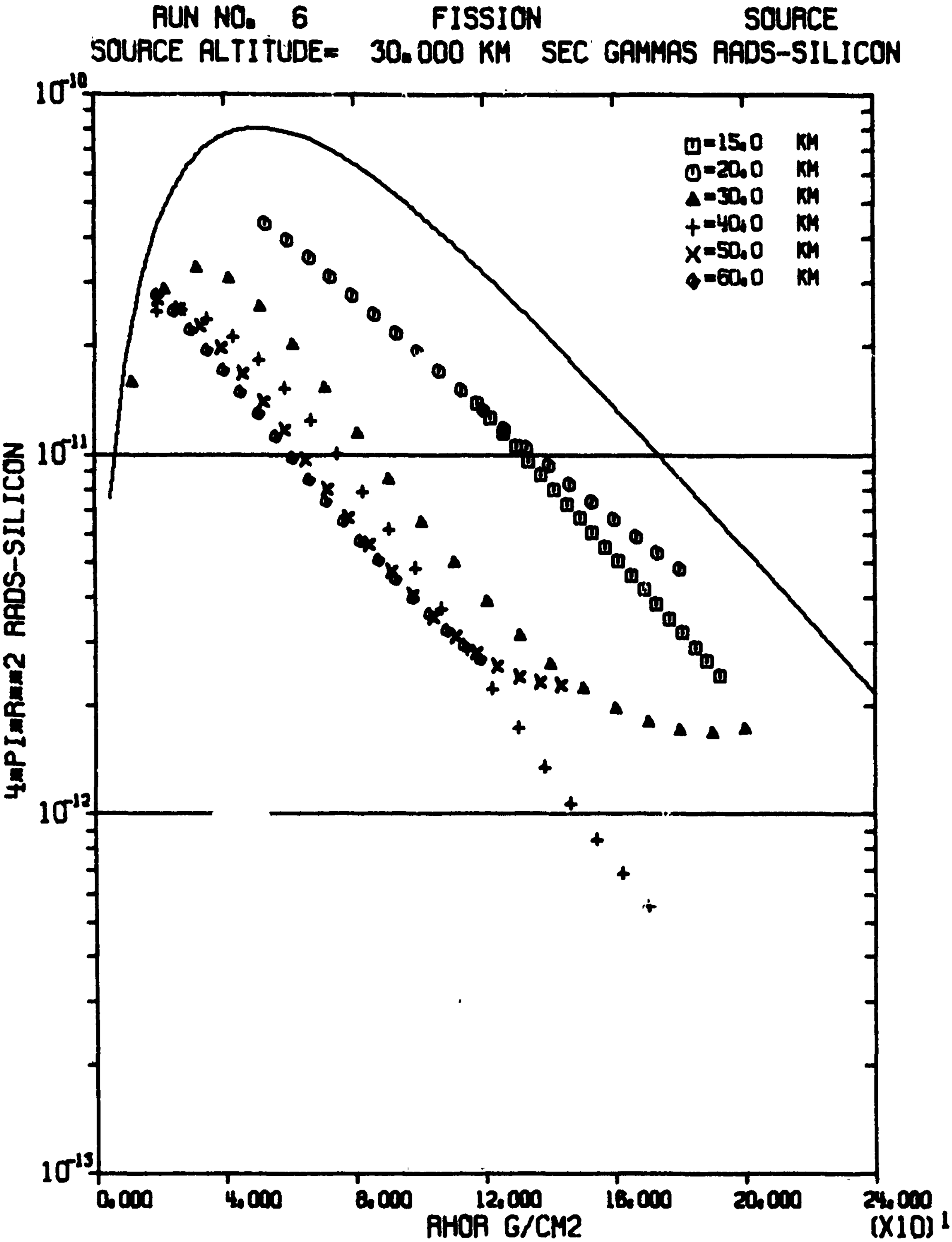


FIGURE C-23 MORSAIR FIT DATA-4PIR**2 GAMMA SI DOSE,
FISSION SOURCE IN REAL AIR AT 30.0 KM.
ALL SAMPLING ALTITUDES

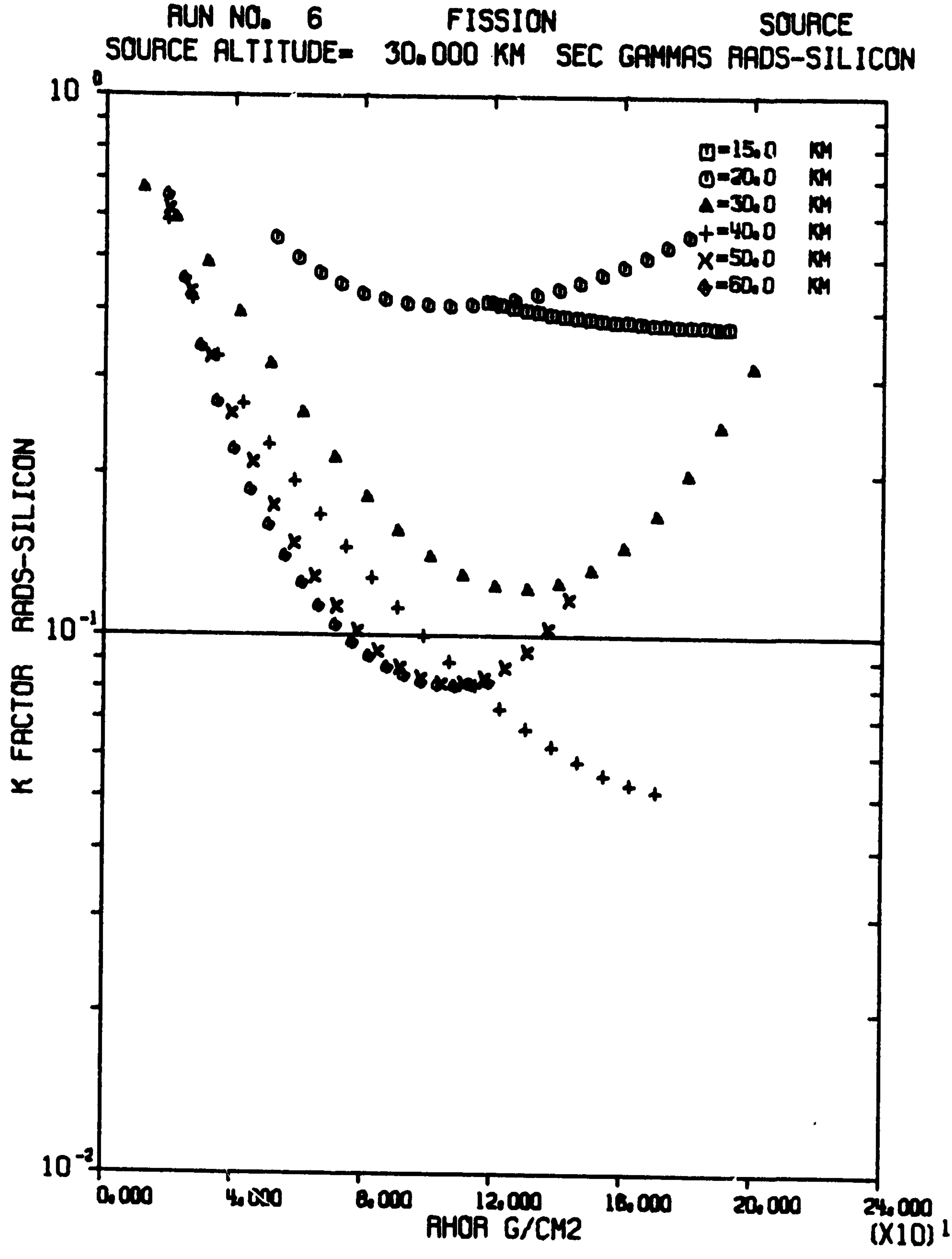


FIGURE C-24 MORSAIR FIT DATA-GAMMA SILICON K-FACTOR, FISSION SOURCE IN REAL AIR AT 30.0 KM. ALL SAMPLING ALTITUDES

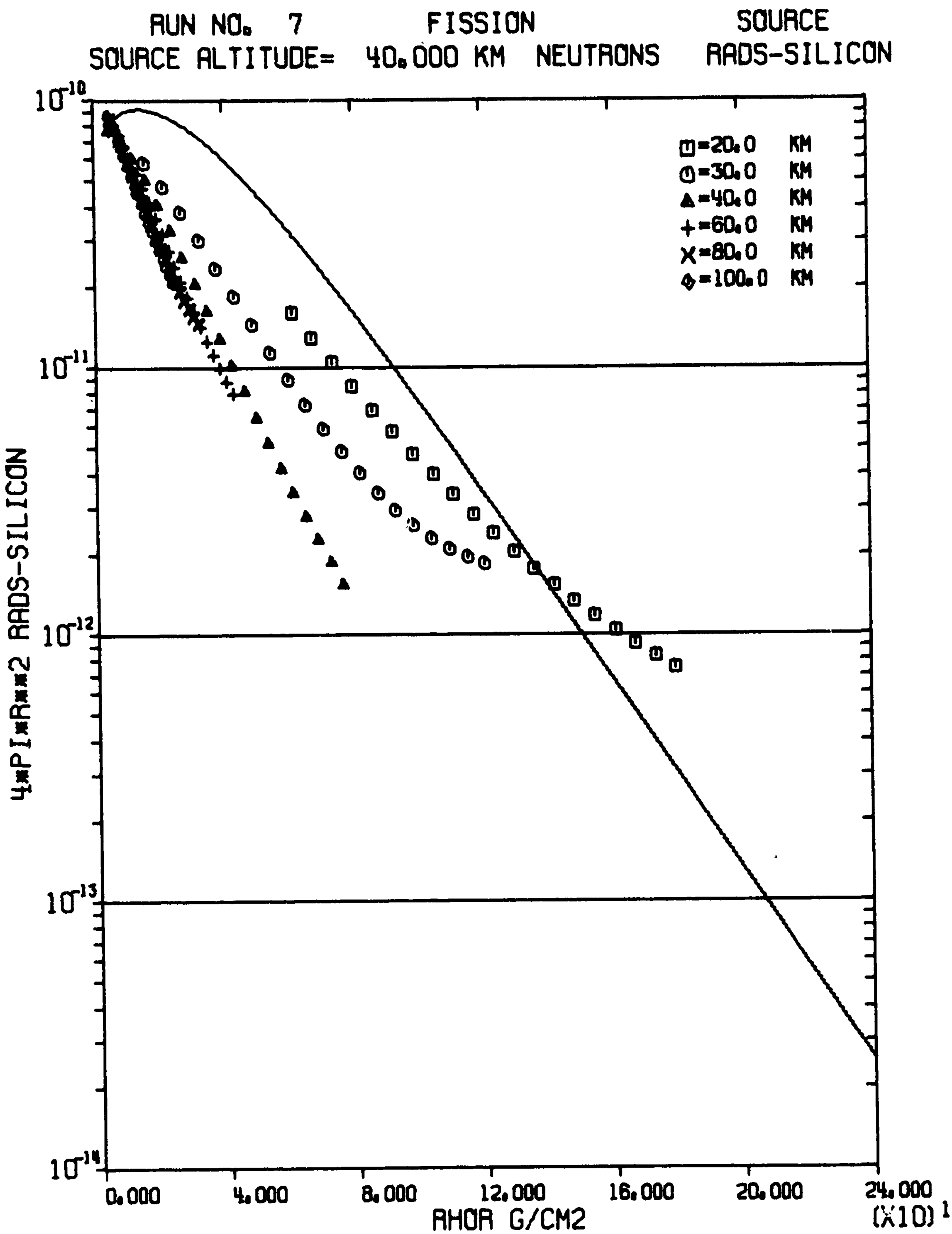


FIGURE 3-25 NORSAIR FIT DATA-4PIR**2 NEUTRON SI DOSE, FISSION SOURCE IN REAL AIR AT 40.0 KM. ALL SAMPLING ALTITUDES

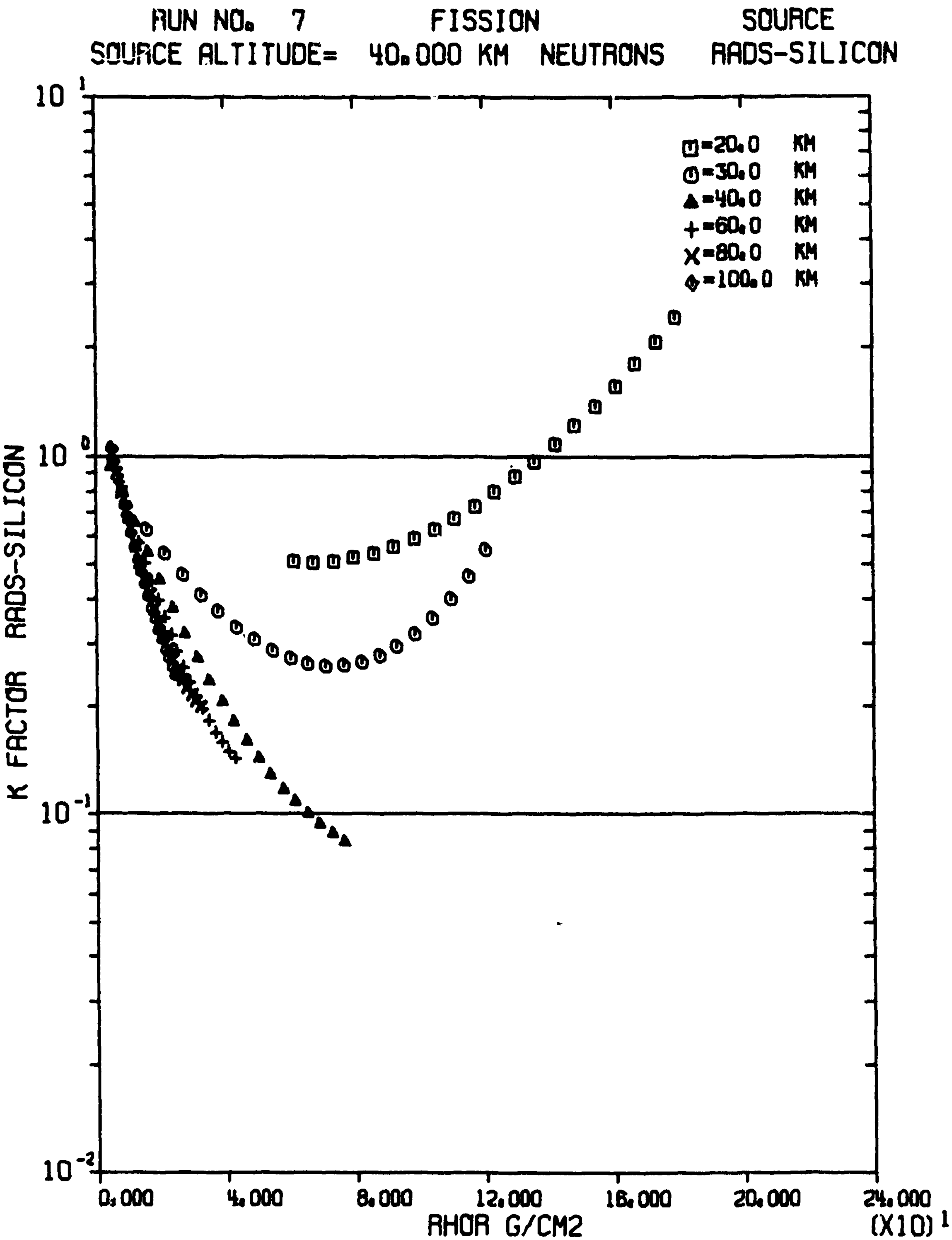


FIGURE 3-26 MORSAIR FIT DATA-NEUTRON SILICON K-FACTOR FISSION SOURCE IN REAL AIR AT 40.0 KM. ALL SAMPLING ALTITUDES

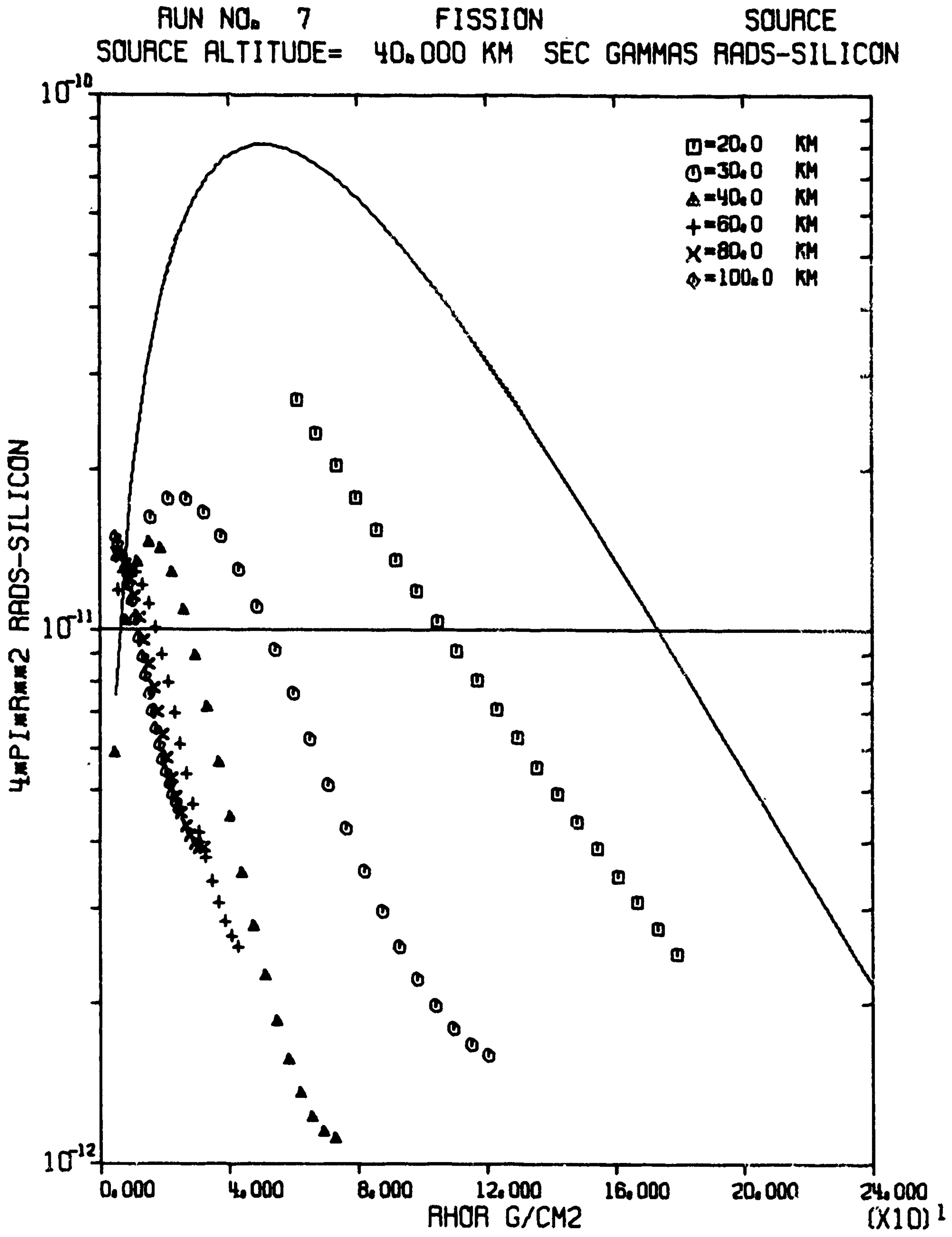


FIGURE C-27 MORSAIR FIT DATA-4PIR**2 GAMMA SI DOSE, FISSION SOURCE IN REAL AIR AT 40.0 KM. ALL SAMPLING ALTITUDES

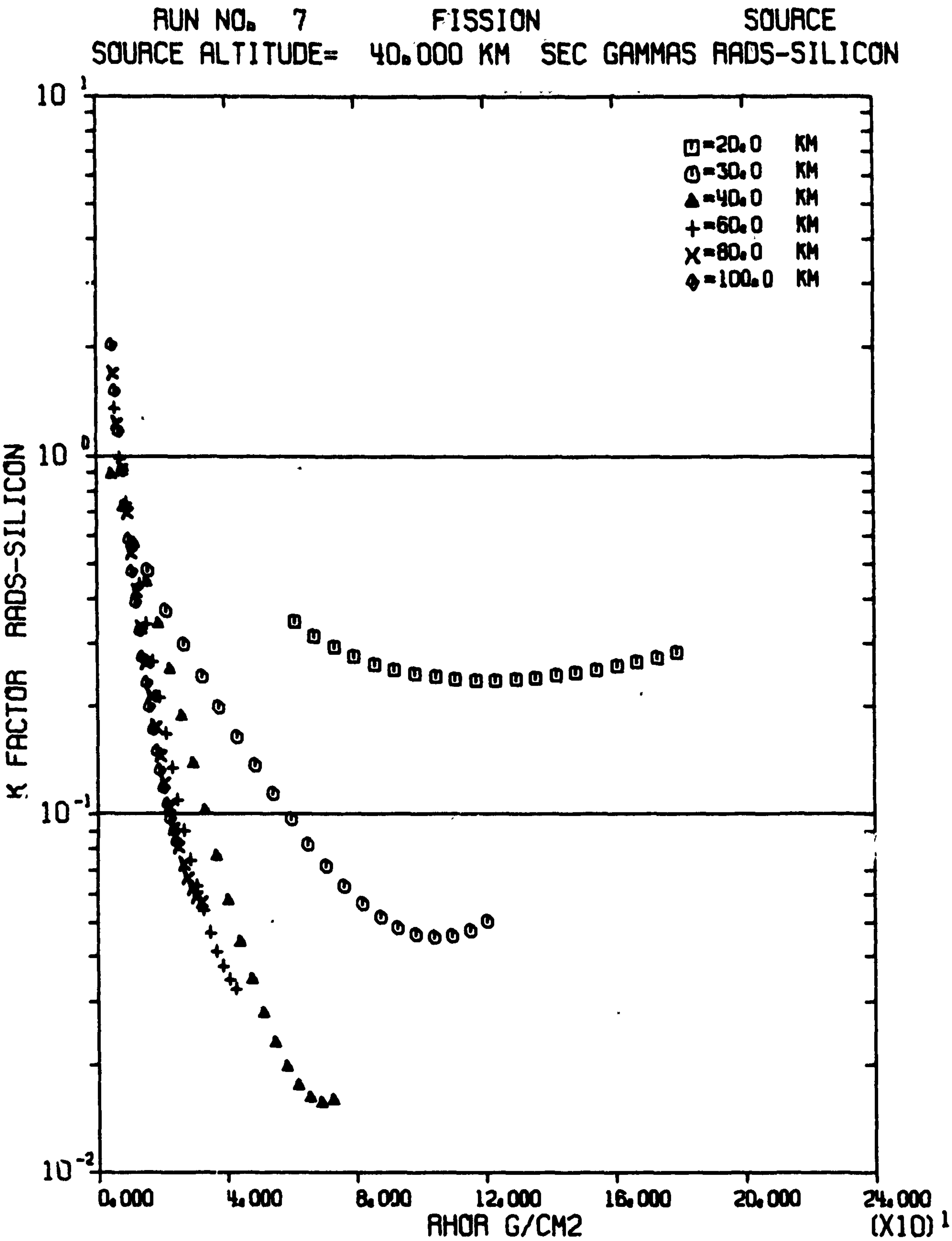


FIGURE C-28 MORSAIR FIT DATA-GAMMA SILICON K-FACTOR, FISSION SOURCE IN REAL AIR AT 40.0 KM. ALL SAMPLING ALTITUDES

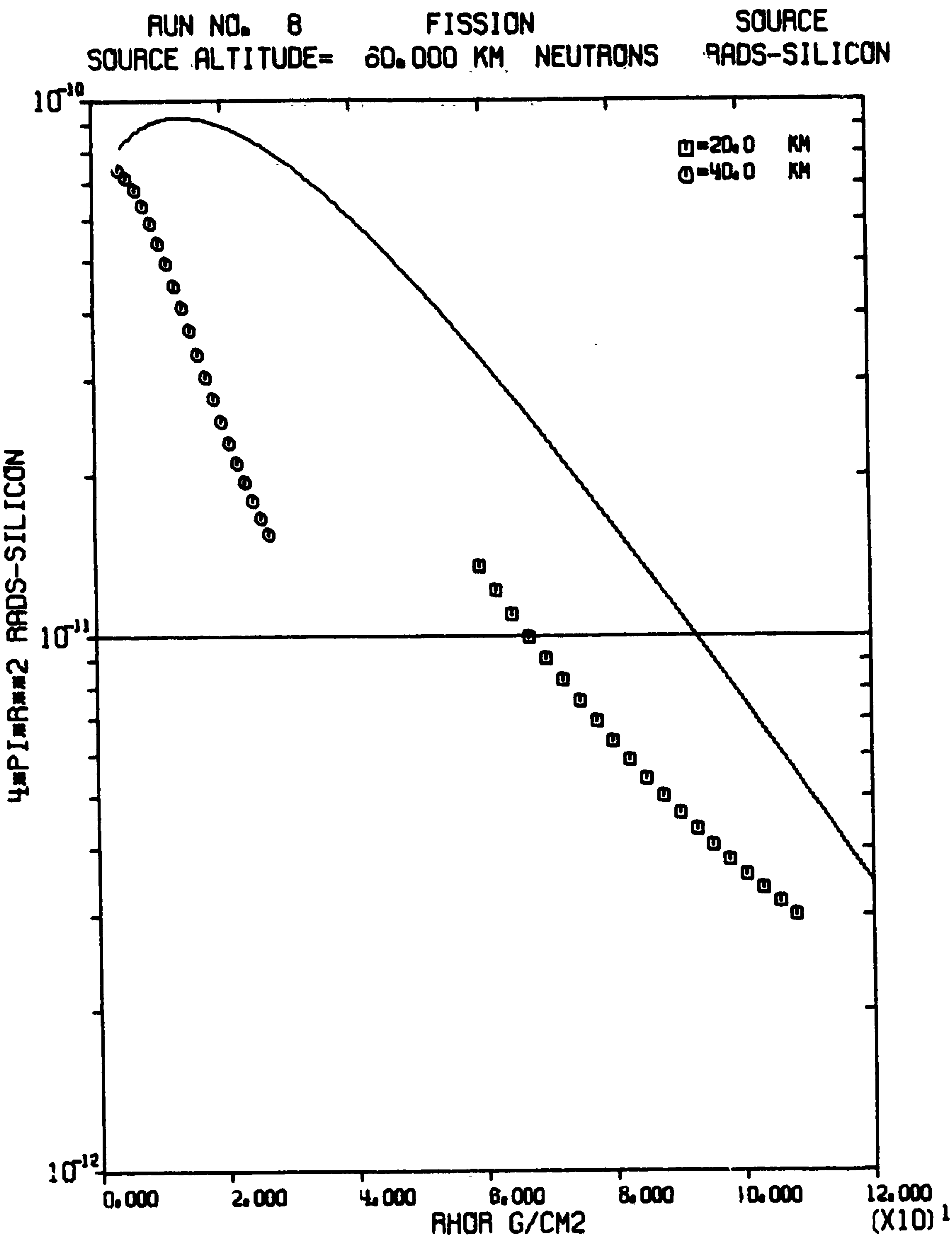


FIGURE C-29 MORSAIR FIT DATA-4PIR**2 NEUTRON SI DOSE, FISSION SOURCE IN REAL AIR AT 60.0 KM. SAMPLING ALTITUDES 20 AND 40 KM.

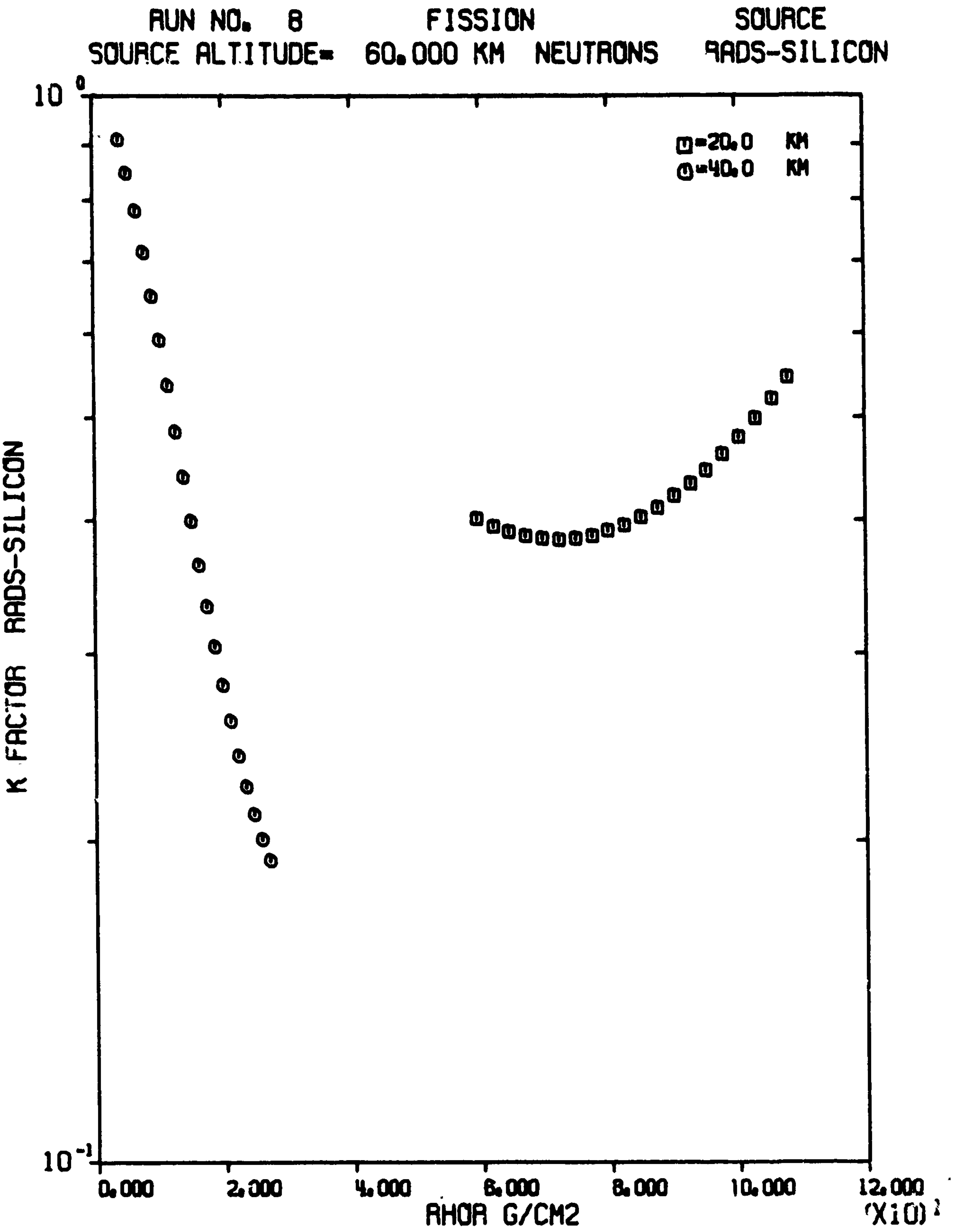


FIGURE C-30 NORSAIR FIT DATA-NEUTRON SILICON K-FACTOR
FISSION SOURCE IN REAL AIR AT 60.0 KM.
SAMPLING ALTITUDES 20 AND 40 KM.

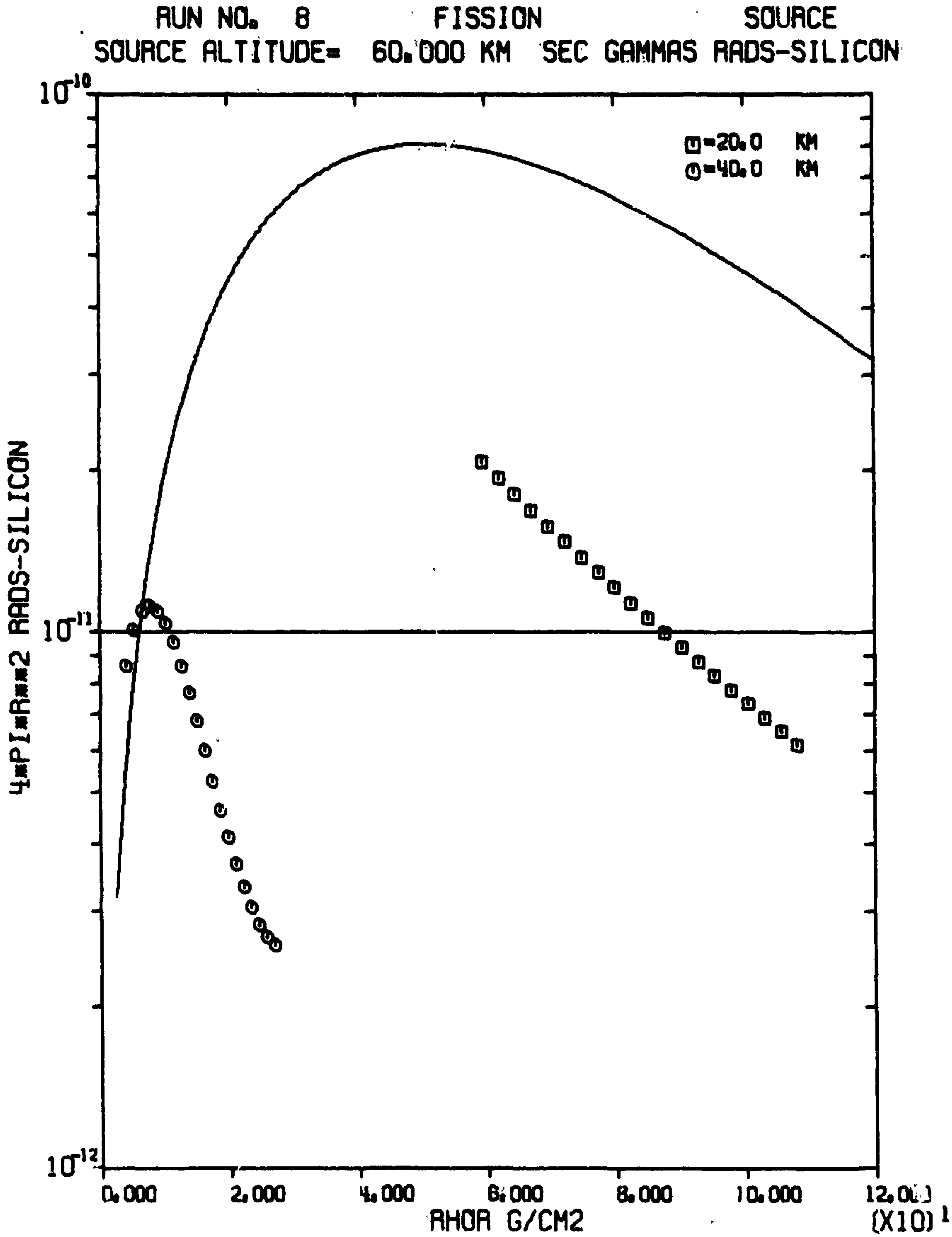


FIGURE [illegible]-31 CORSAIR FIT DATA-4PIR**2 GAMMA SI DOSE,
FISSION SOURCE IN REAL AIR AT 60.0 KM.
SAMPLING ALTITUDES 20 AND 40 KM.

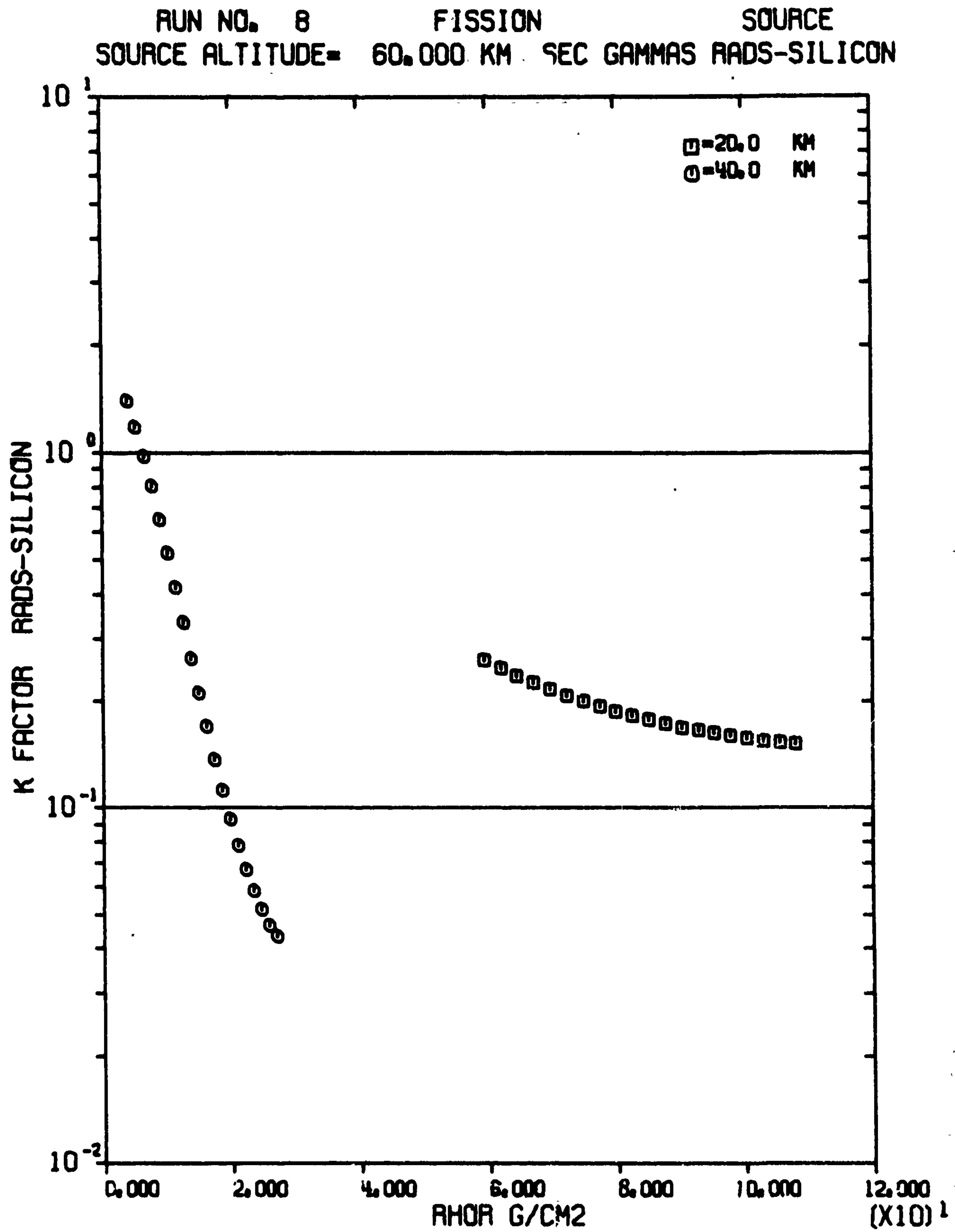


FIGURE C-32 MORSAIR FIT DATA-GAMMA SILICON K-FACTOR, FISSION SOURCE IN REAL AIR AT 60.0 KM. SAMPLING ALTITUDES 20 AND 40 KM.

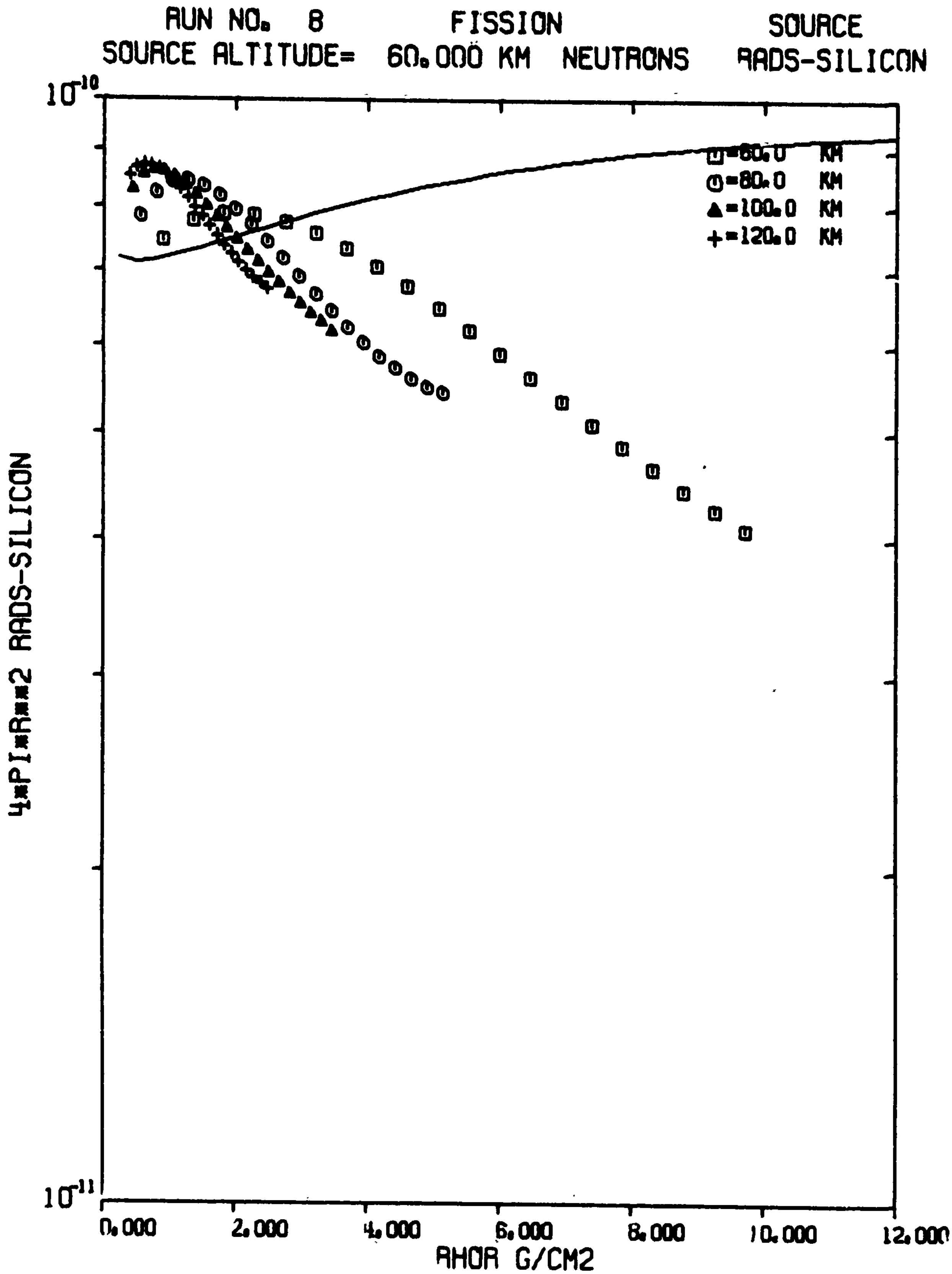


FIGURE C-33 MORSAIR FIT DATA-4PIR**2 NEUTRON SI DOSE, FISSION SOURCE IN REAL AIR AT 60.0 KM. SAMPLING ALTITUDES 60,80,100, AND 120 KM.

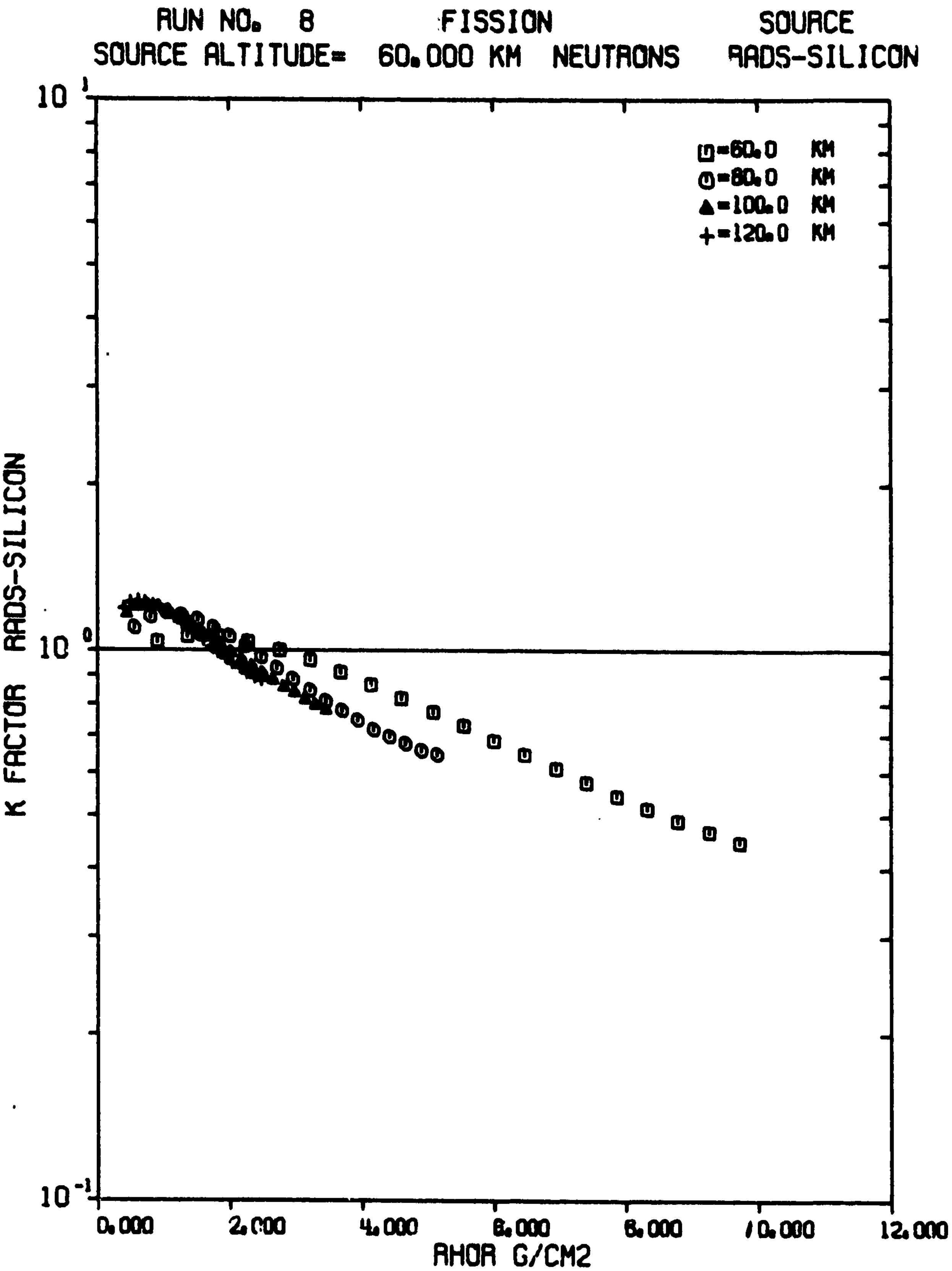


FIGURE C-34 MORSAIR FIT DATA-NEUTRON SILICON K-FACTOR
FISSION SOURCE IN REAL AIR AT 60.0 KM.
SAMPLING ALTITUDES 60,80,100, AND 120 KM.

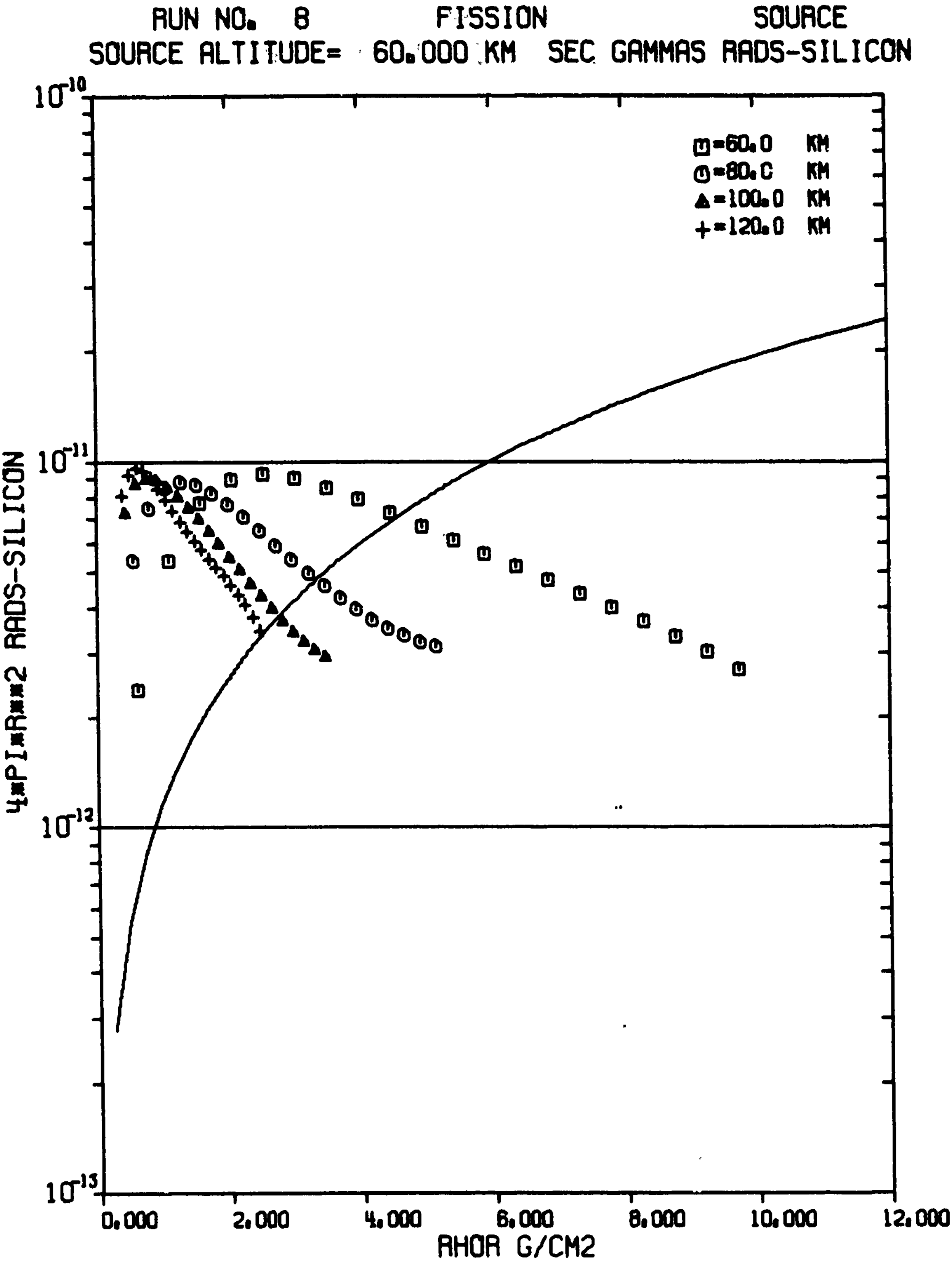


FIGURE 3-35 MORSAIR FIT DATA-4PIR**2 GAMMA SI DOSE, FISSION SOURCE IN REAL AIR AT 60.0 KM. SAMPLING ALTITUDES 60,80,100, AND 120 KM.

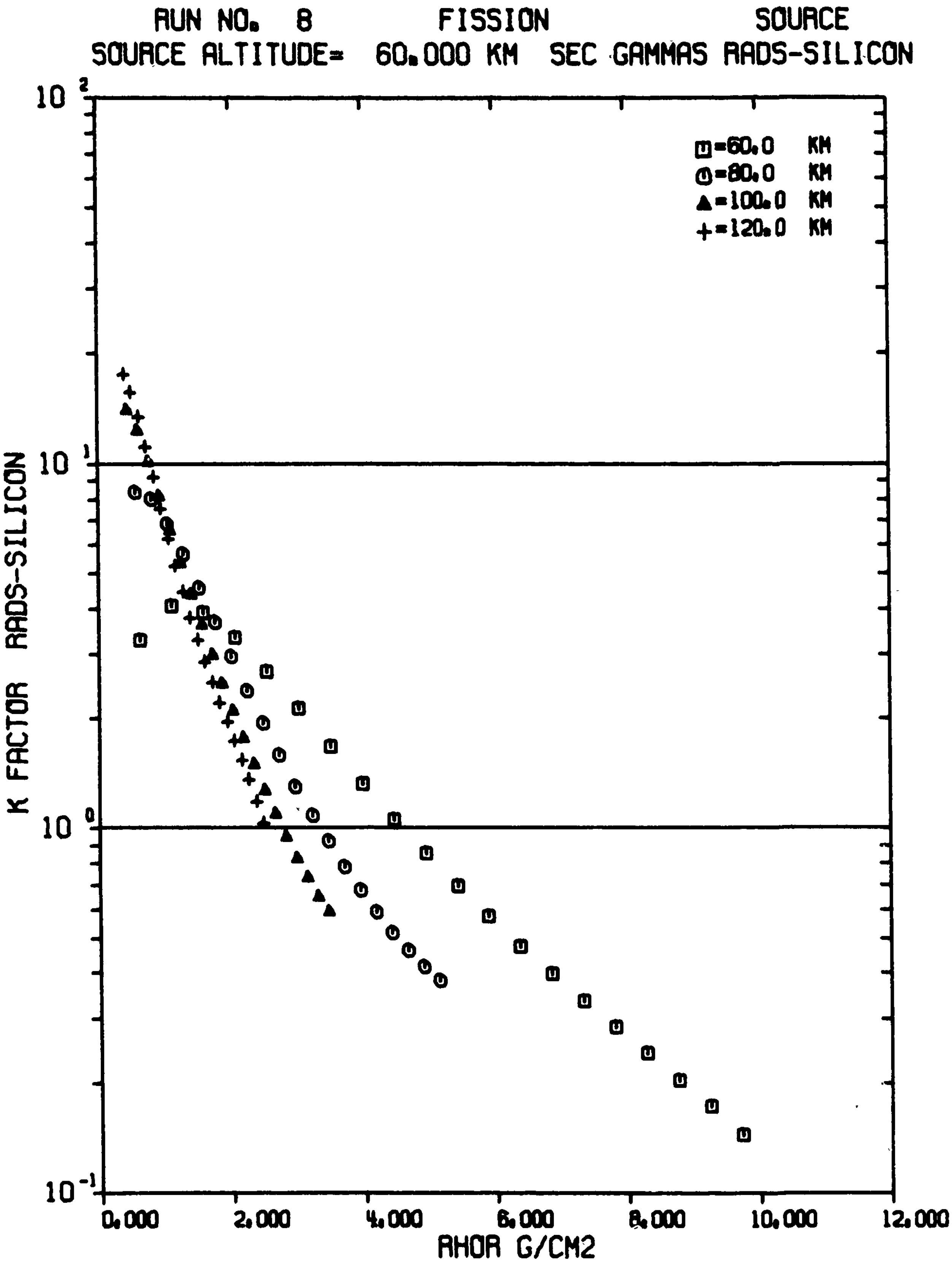


FIGURE C-36 MORSAIR FIT DATA-GAMMA SILICON K-FACTOR, FISSION SOURCE IN REAL AIR AT 60.0 KM. SAMPLING ALTITUDES 60,80,100, AND 120 KM.

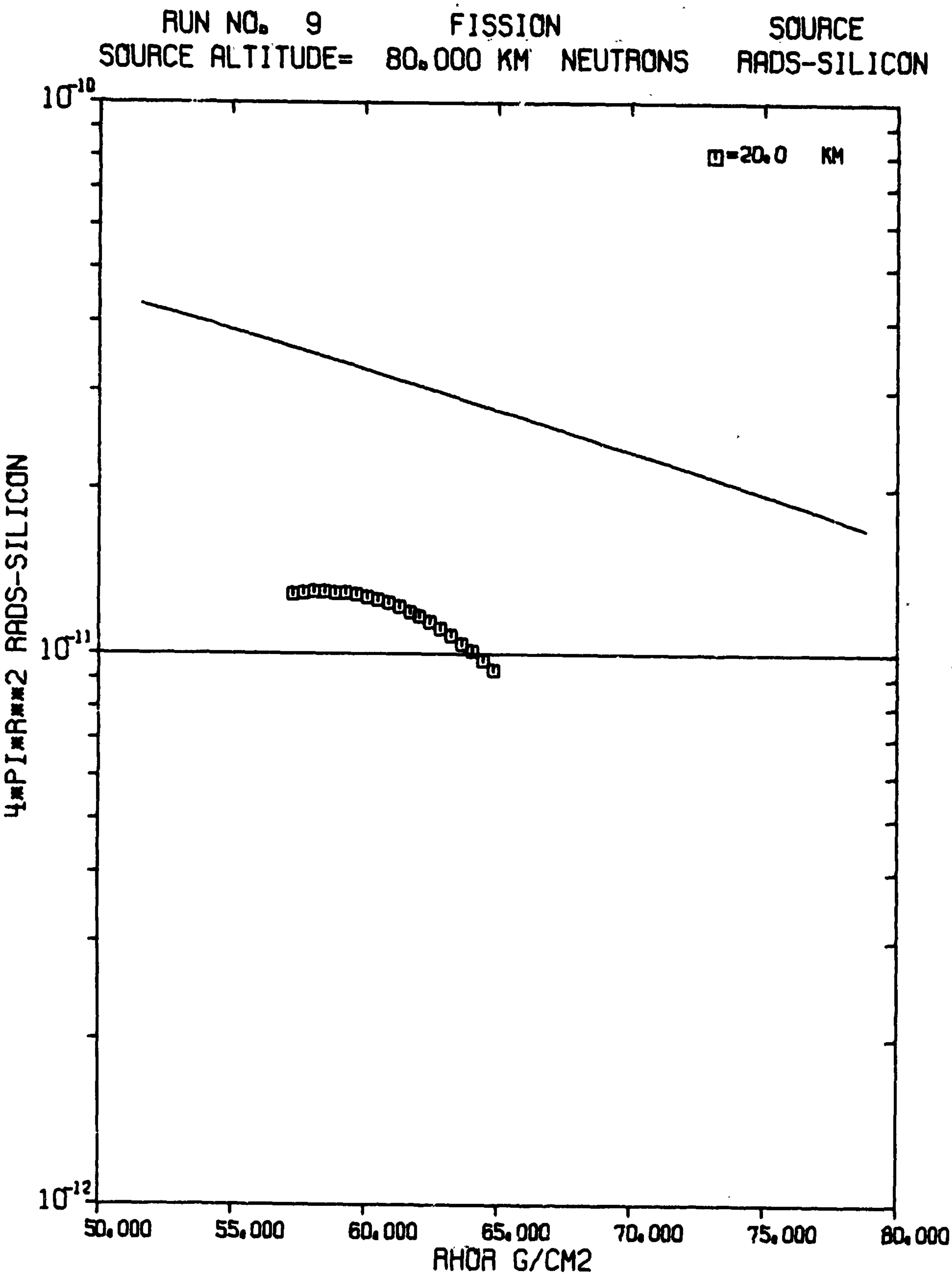


FIGURE C-37 MORSAIR FIT DATA-4PIR**2 NEUTRON SI DOSE, FISSION SOURCE IN REAL AIR AT 80.0 KM. SAMPLING ALTITUDES 20 KILOMETERS.

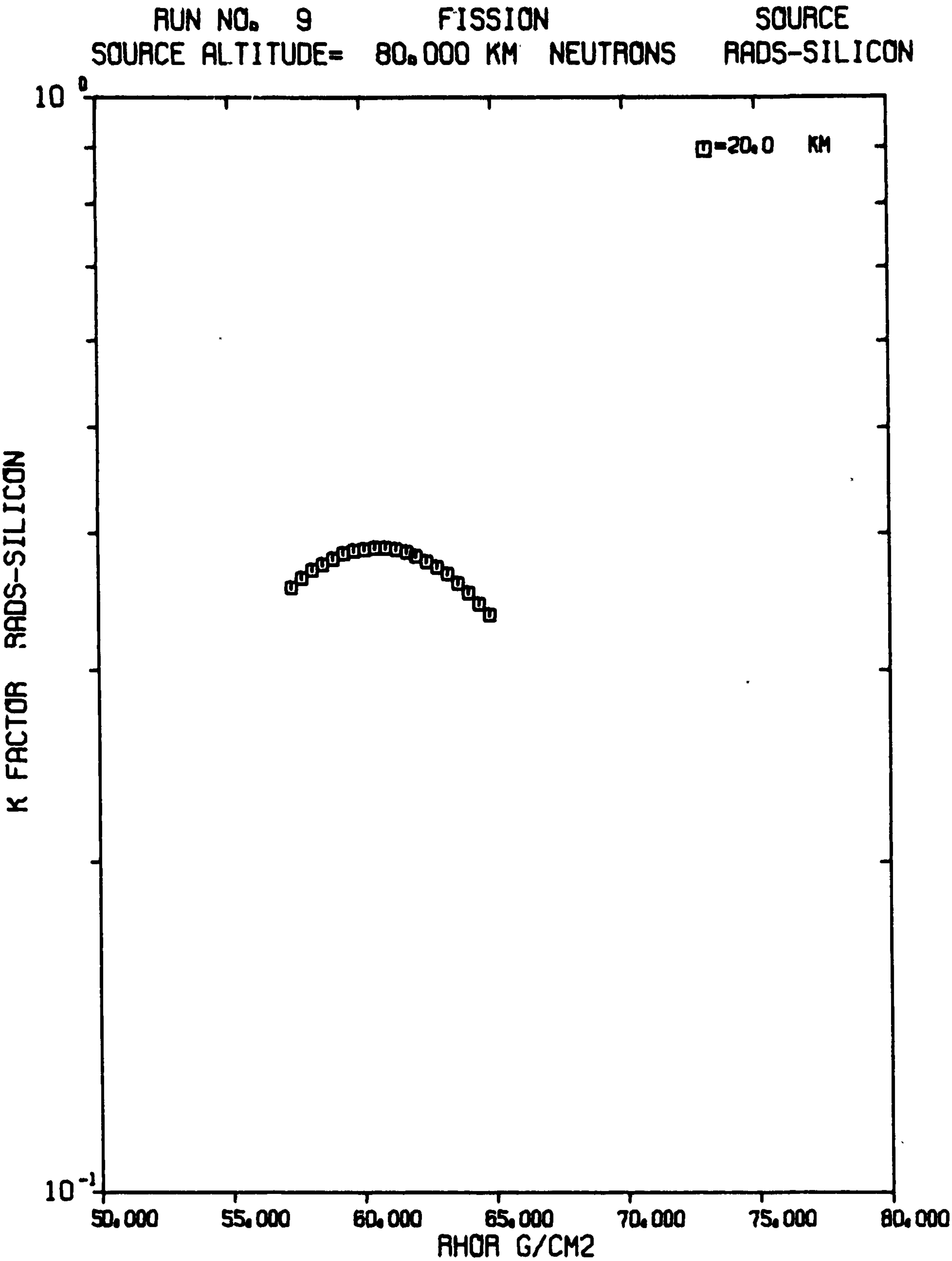


FIGURE C-38 NORSAIR FIT DATA-NEUTRON SILICON K-FACTOR FISSION SOURCE IN REAL AIR AT 80.0 KM. SAMPLING ALTITUDES 20 KILOMETERS.

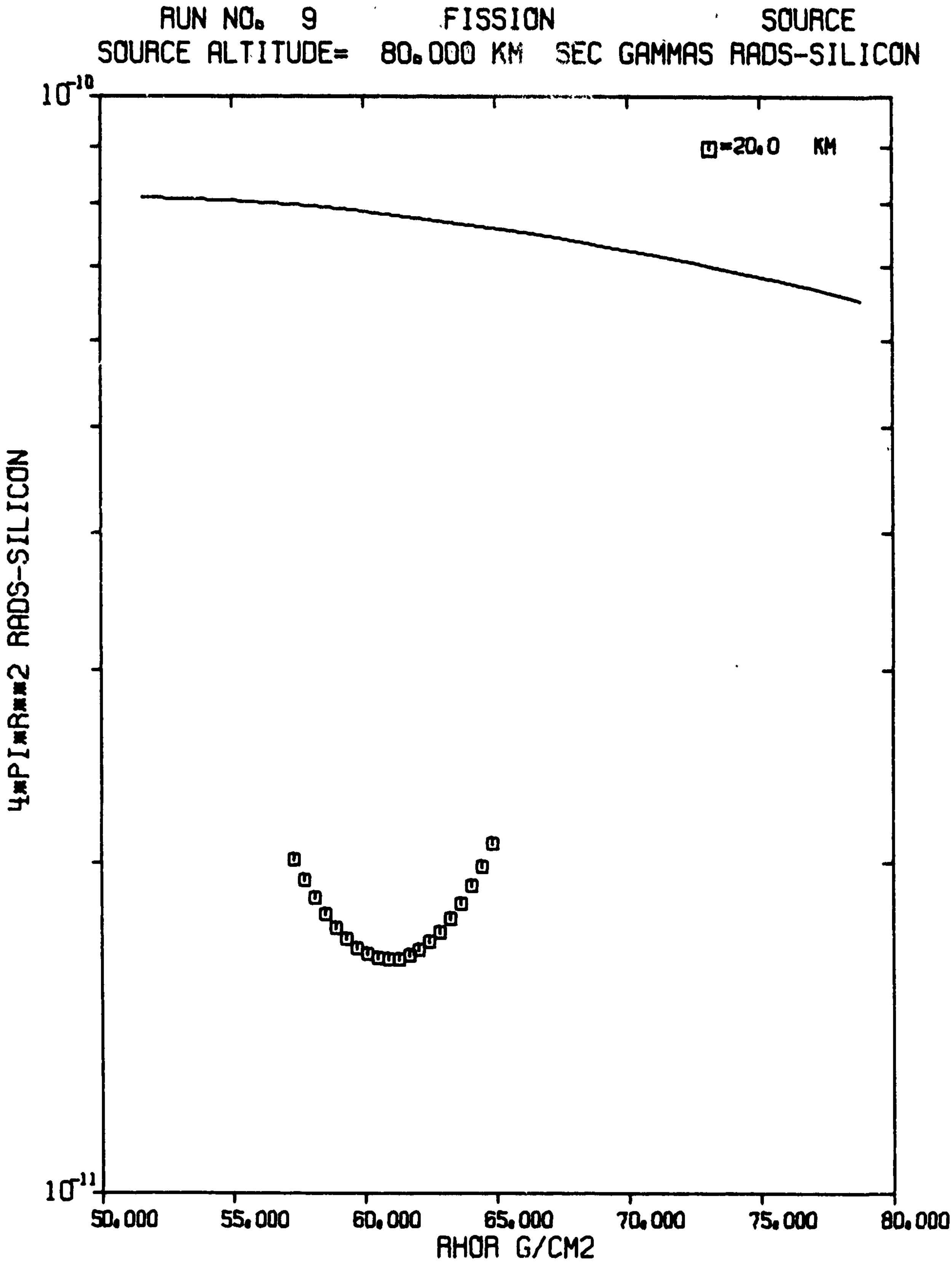


FIGURE C-39 MORSAIR FIT DATA-4PIR**2 GAMMA SI DOSE, FISSION SOURCE IN REAL AIR AT 80.0 KM. SAMPLING ALTITUDES 20 KILOMETERS.

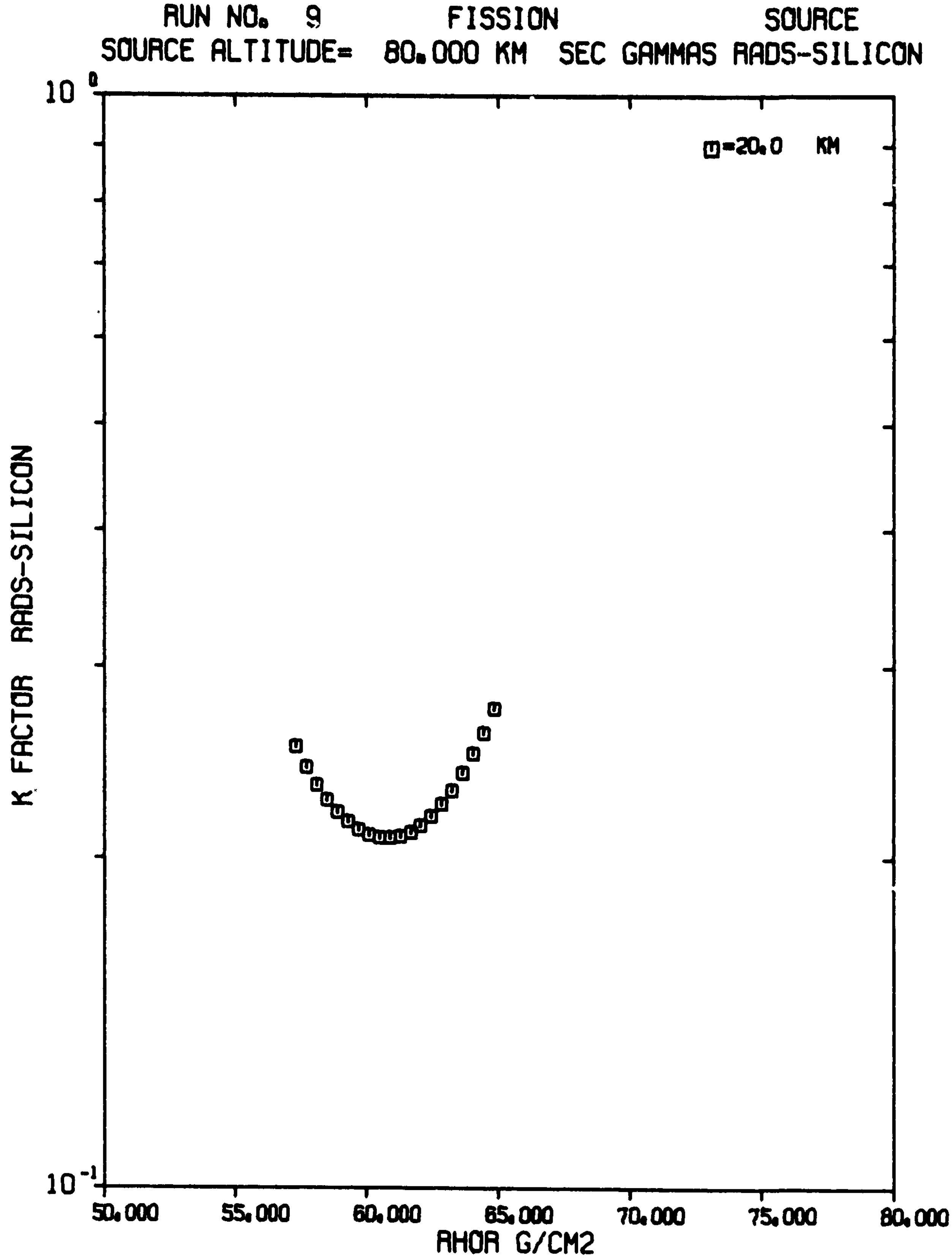


FIGURE 3-40 MORSAIR FIT DATA-GAMMA SILICON K-FACTOR, FISSION SOURCE IN REAL AIR AT 80.0 KM. SAMPLING ALTITUDES 20 KILOMETERS.

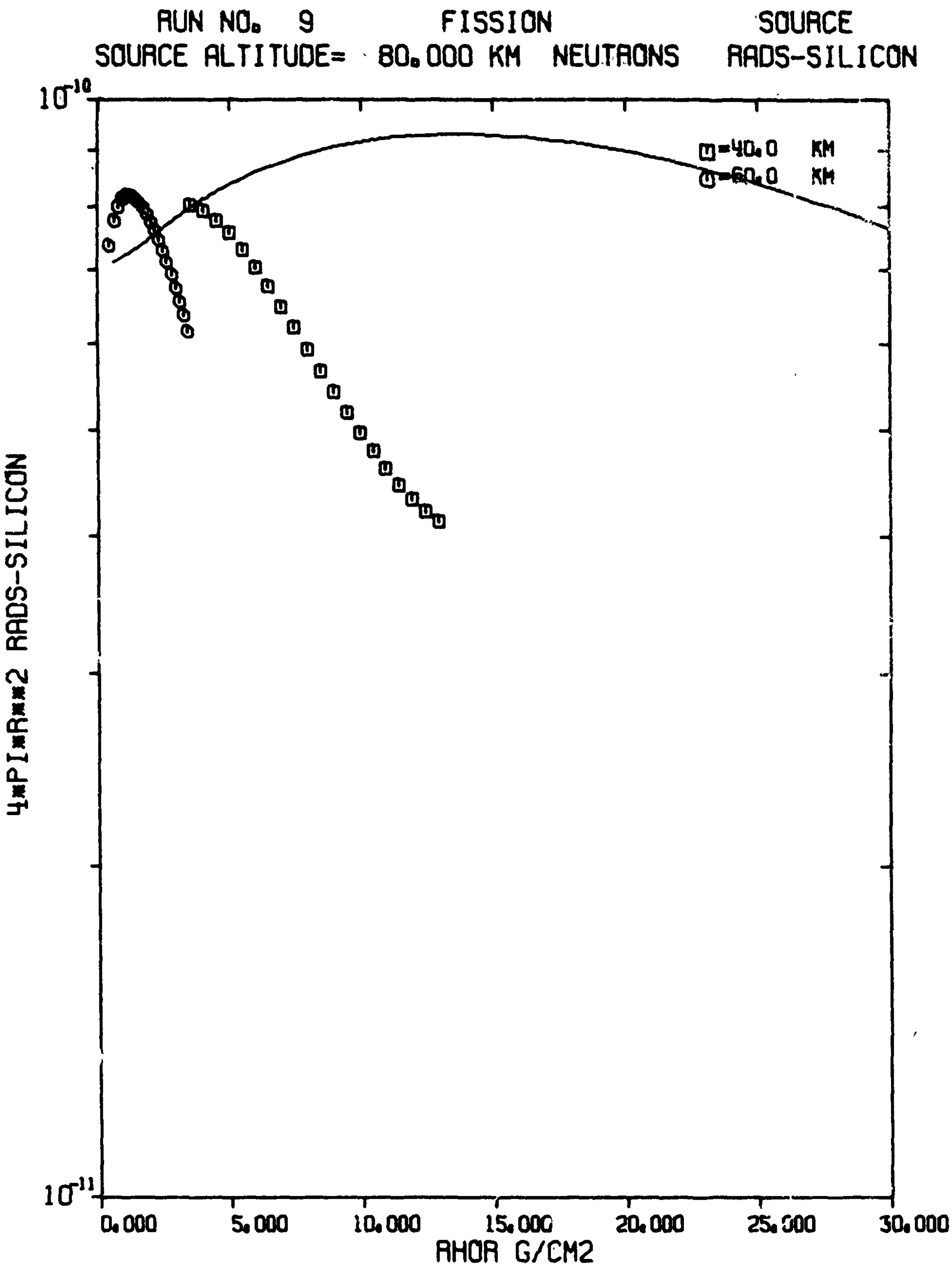


FIGURE C-41 MORSAIR FIT DATA-4PIR**2 NEUTRON SI DOSE, FISSION SOURCE IN REAL AIR AT 80.0 KM. SAMPLING ALTITUDES 40 AND 60 KM.

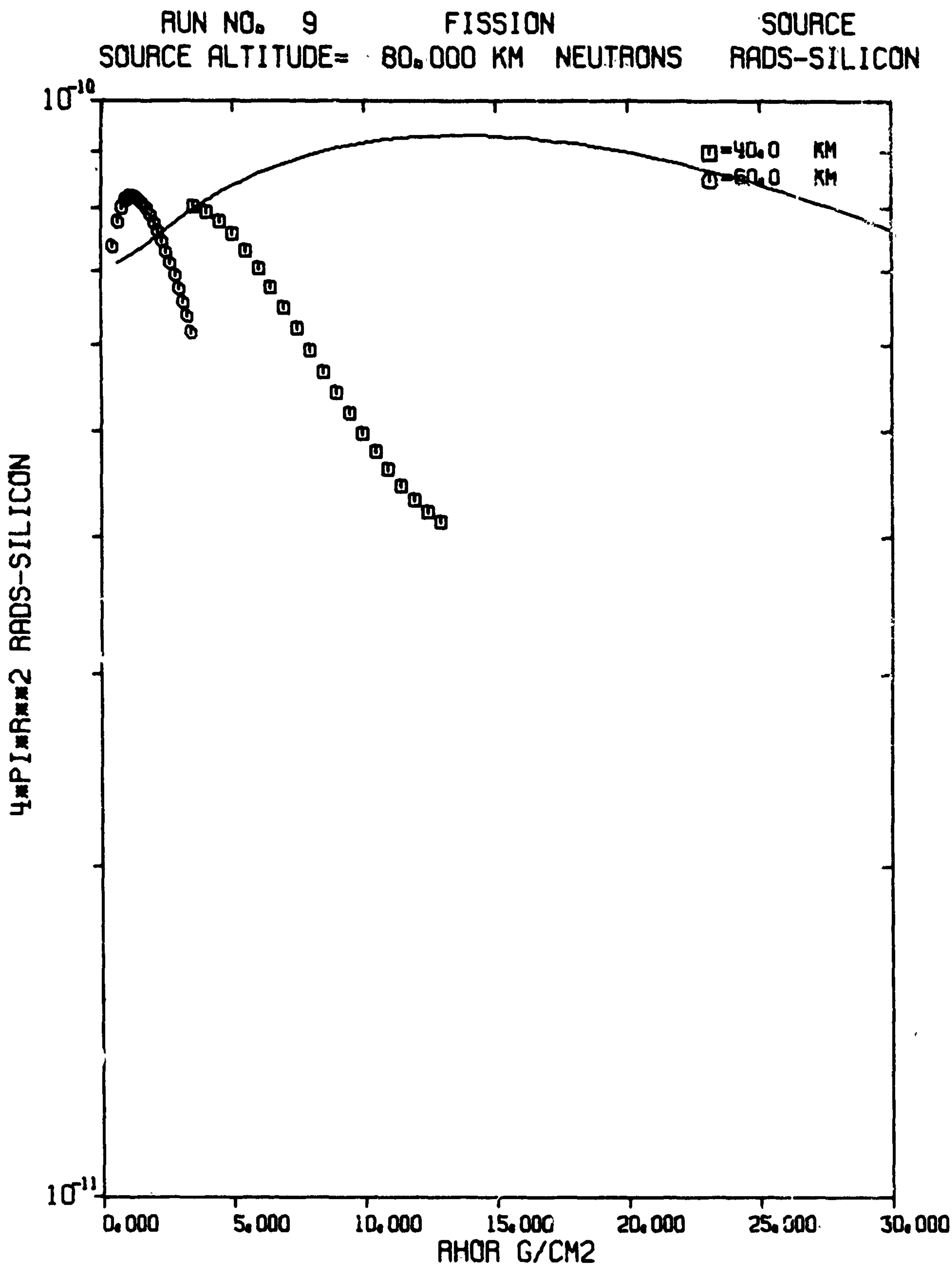


FIGURE C-41 MORSAIR FIT DATA-4PIR**2 NEUTRON SI DOSE, FISSION SOURCE IN REAL AIR AT 80.0 KM. SAMPLING ALTITUDES 40 AND 60 KM.

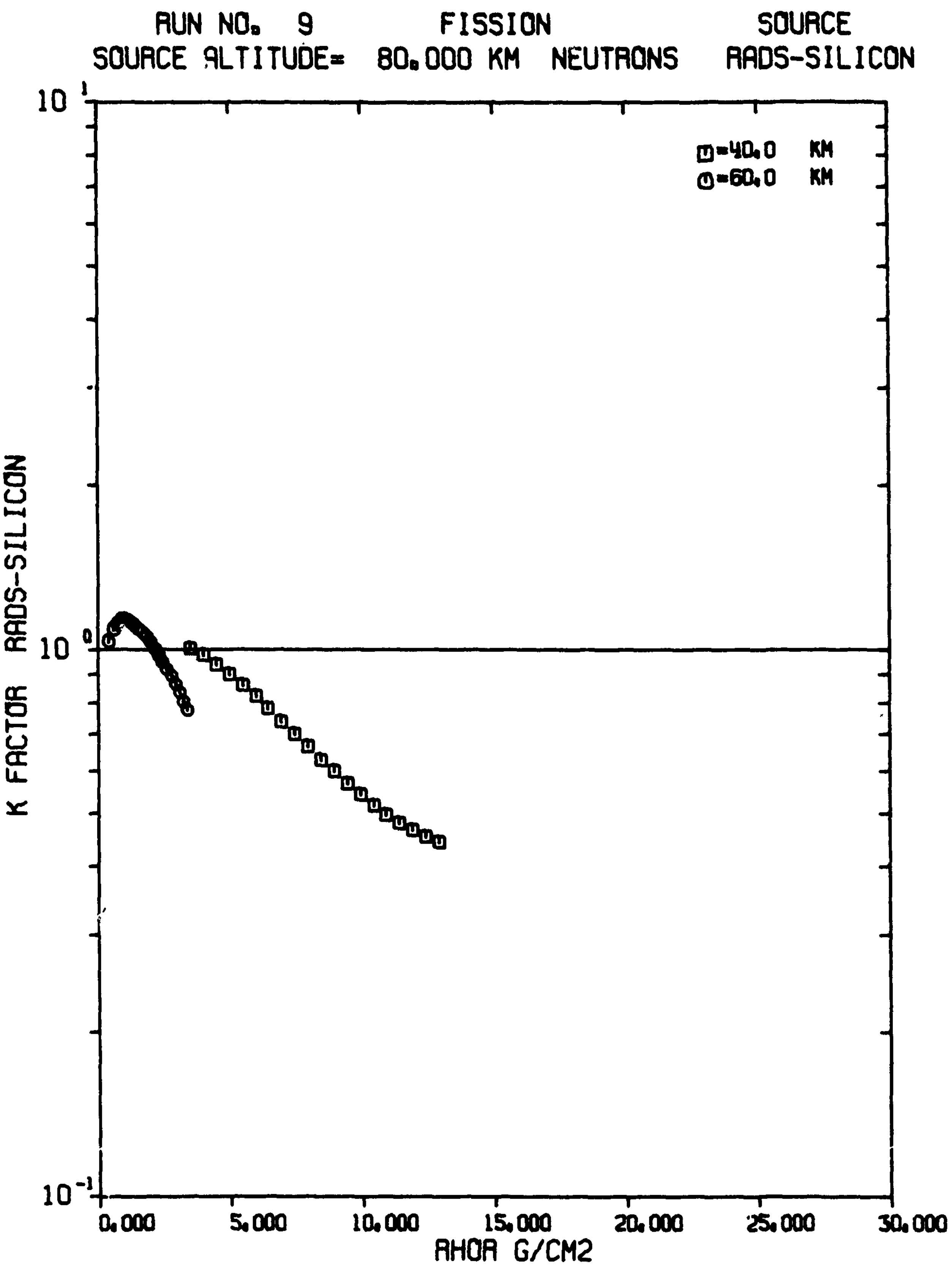


FIGURE C-42 MORSAIR FIT DATA-NEUTRON SILICON K-FACTOR
FISSION SOURCE IN REAL AIR AT 80.0 KM.
SAMPLING ALTITUDES 40 AND 60 KM.

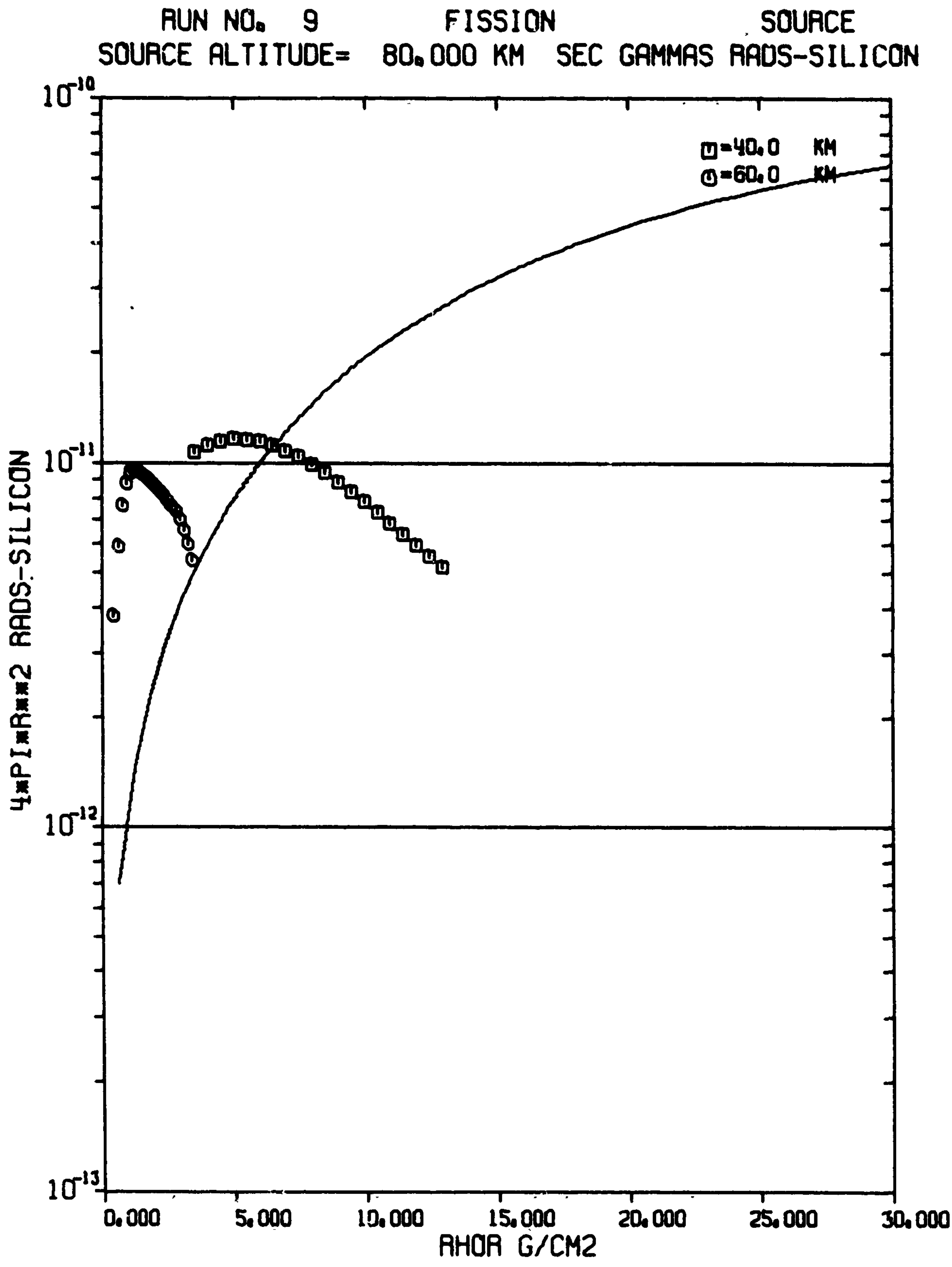


FIGURE C-43 MORSAIR FIT DATA-4PIR**2 GAMMA SI DOSE, FISSION SOURCE IN REAL AIR AT 80.0 KM. SAMPLING ALTITUDES 40 AND 60 KM.

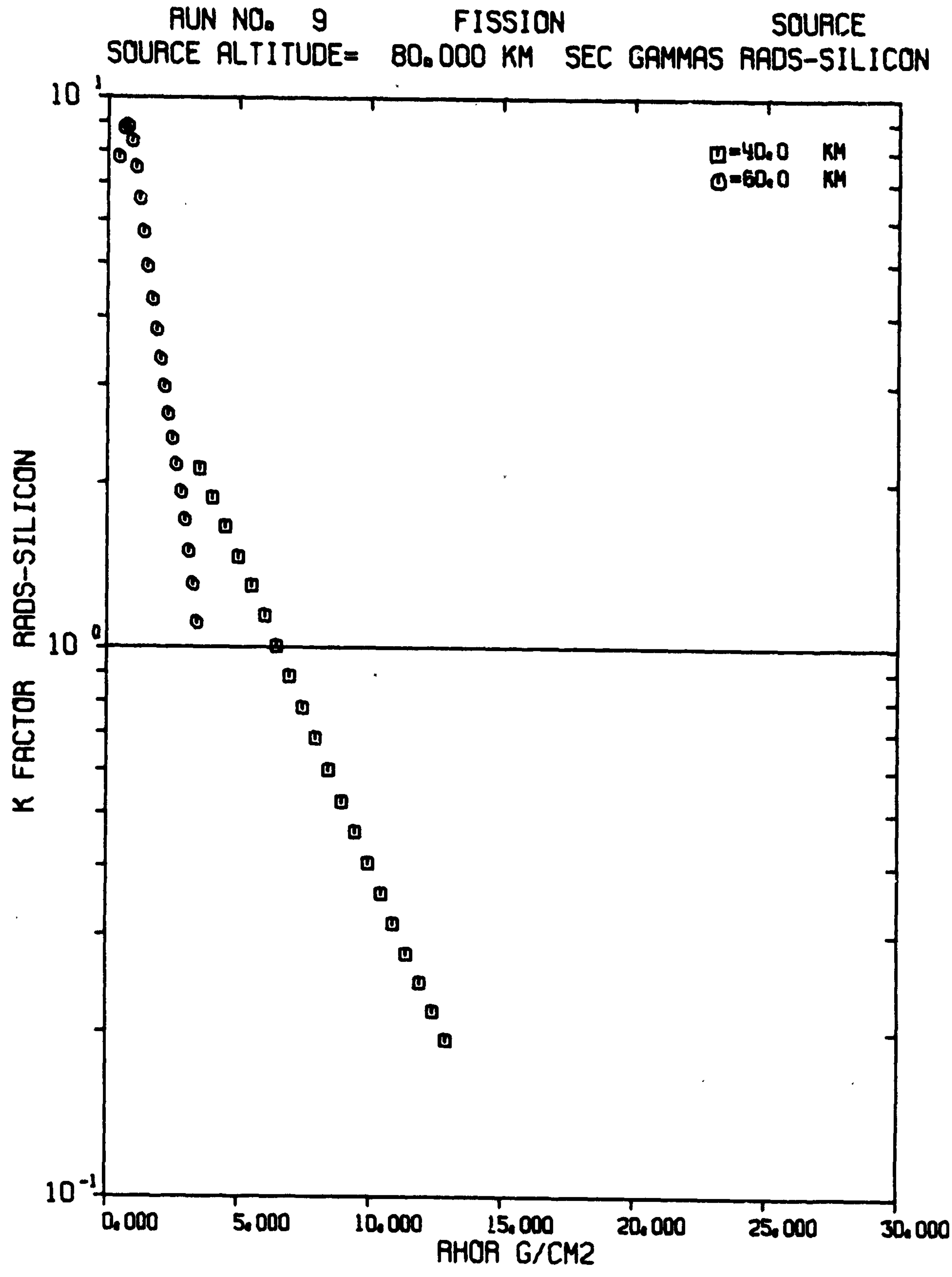


FIGURE C-44 MORSAIR FIT DATA-GAMMA SILICON K-FACTOR, FISSION SOURCE IN REAL AIR AT 80.0 KM. SAMPLING ALTITUDES 40 AND 60 KM.

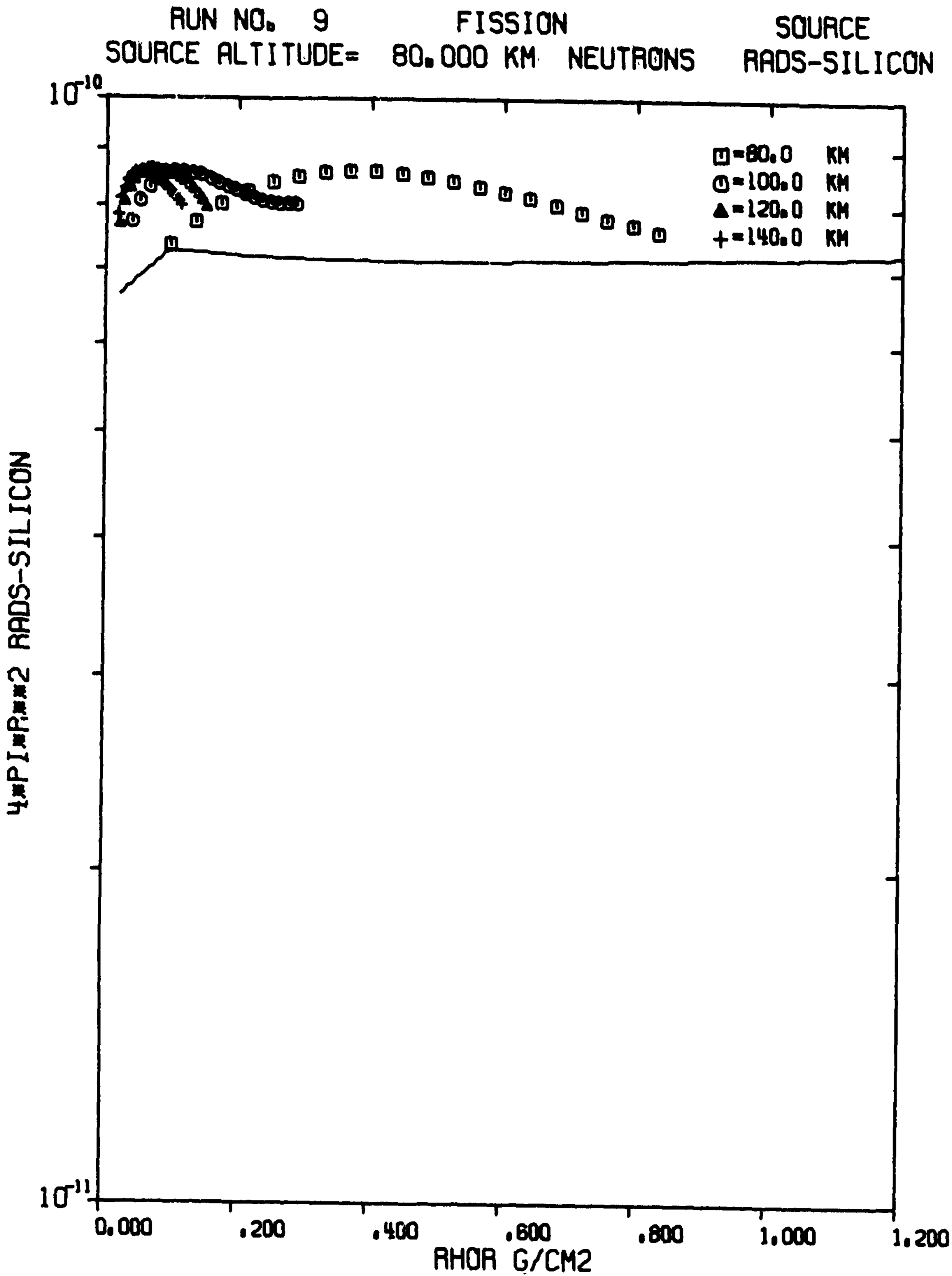


FIGURE C-45 MORSAIR FIT DATA-4PIR**2 NEUTRON SI DOSE, FISSION SOURCE IN REAL AIR AT 80.0 KM. SAMPLING ALTITUDES 80,100,120, AND 140 KM.

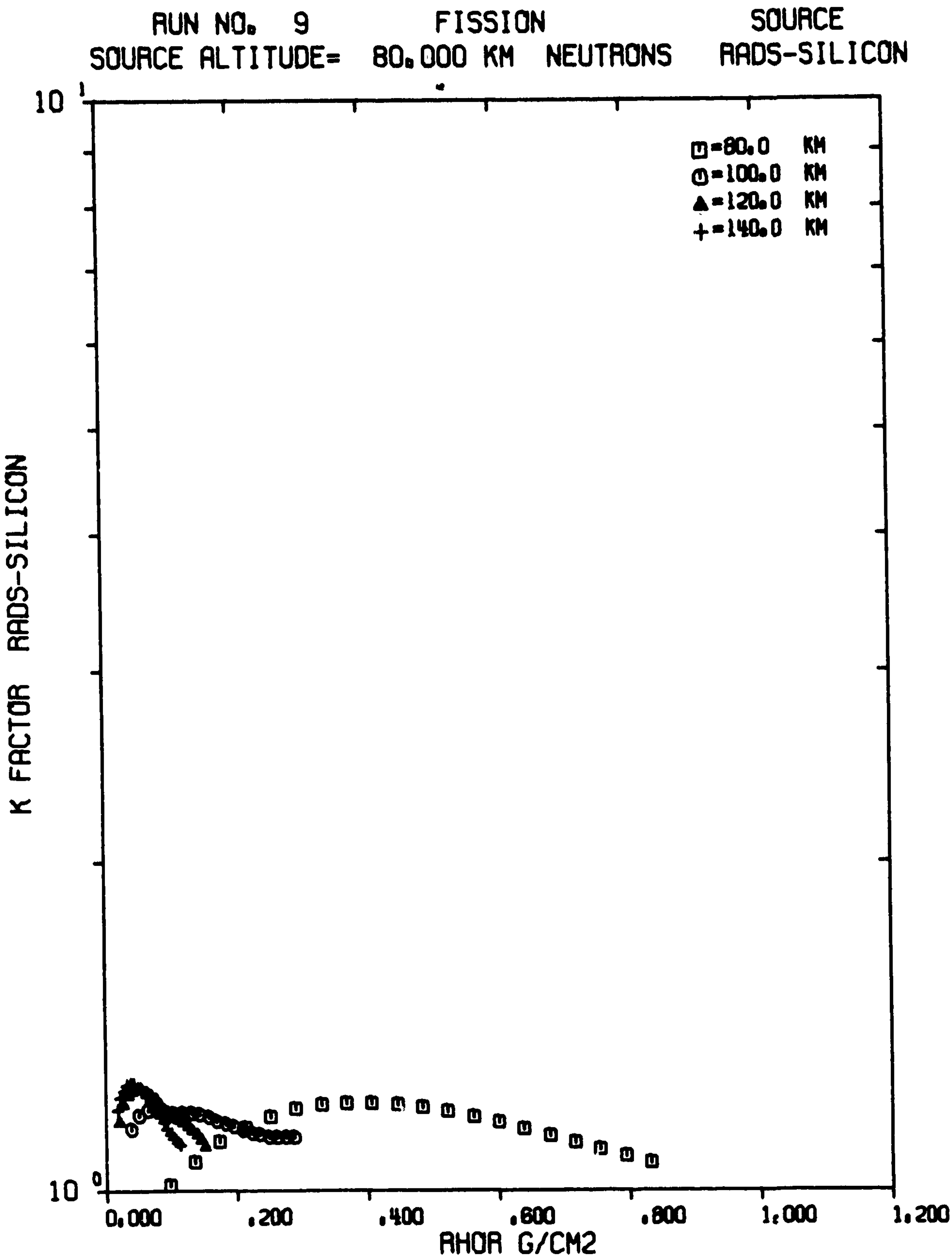


FIGURE C-46 MORSAIR FIT DATA-NEUTRON SILICON K-FACTOR
FISSION SOURCE IN REAL AIR AT 80.0 KM.
SAMPLING ALTITUDES 80,100,120, AND 140 KM.

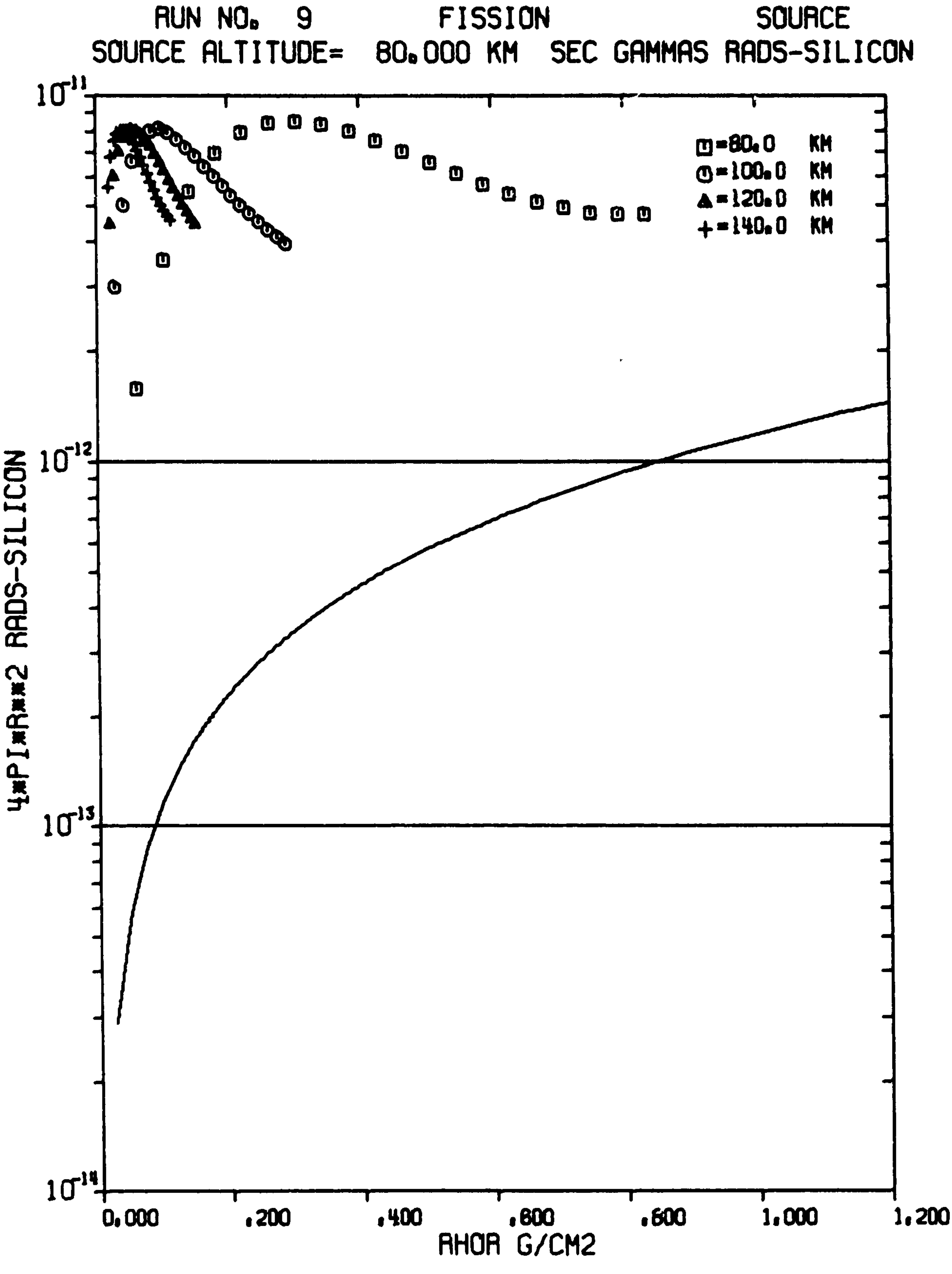


FIGURE C-47 MORSAIR FIT DATA-4PIR**2 GAMMA SI DOSE, FISSION SOURCE IN REAL AIR AT 80.0 KM. SAMPLING ALTITUDES 80,100,120, AND 140 KM.

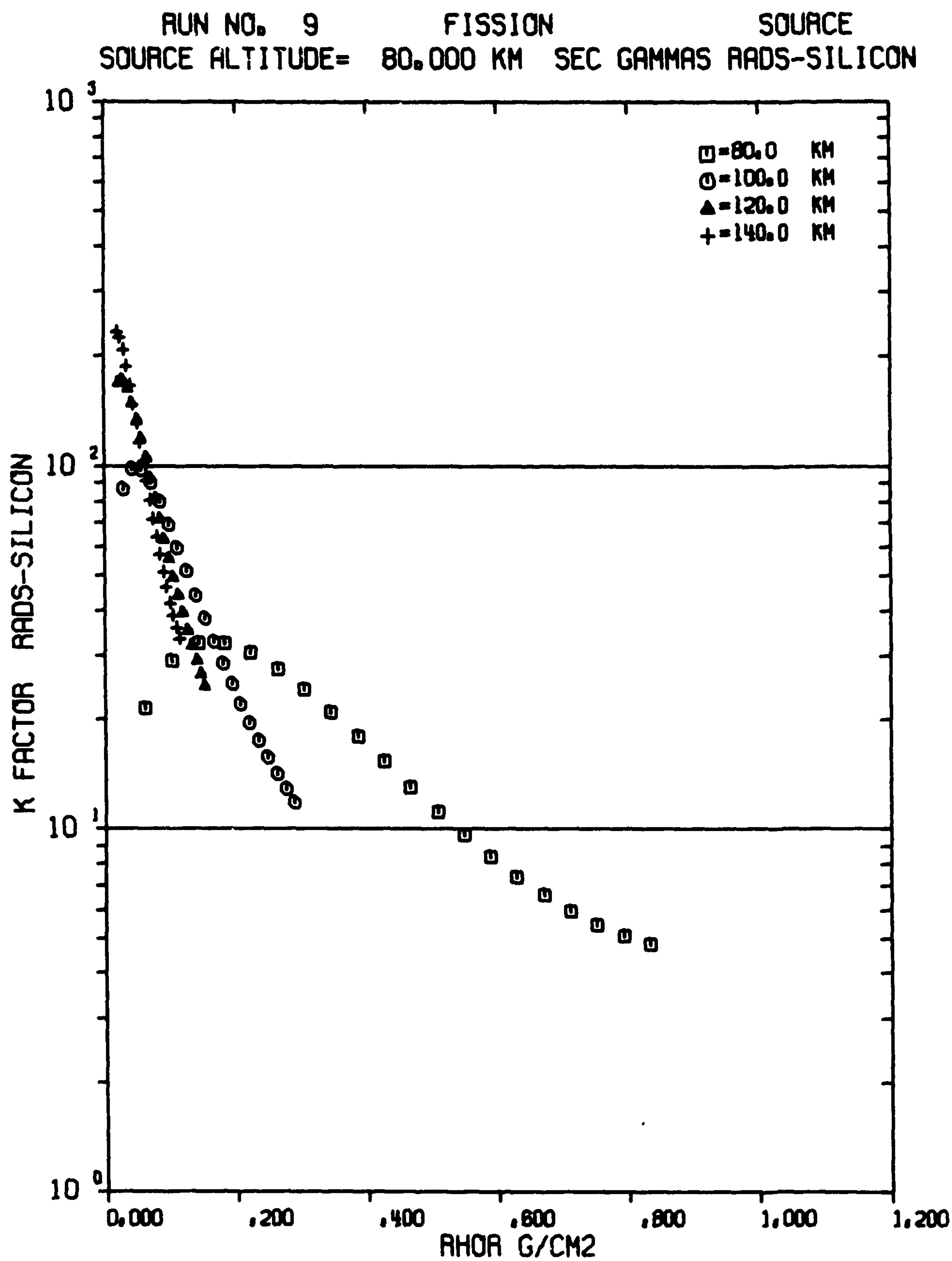


FIGURE C-48 MORSAIR FIT DATA-GAMMA SILICON K-FACTOR, FISSION SOURCE IN REAL AIR AT 80.0 KM. SAMPLING ALTITUDES 80,100,120, AND 140 KM.

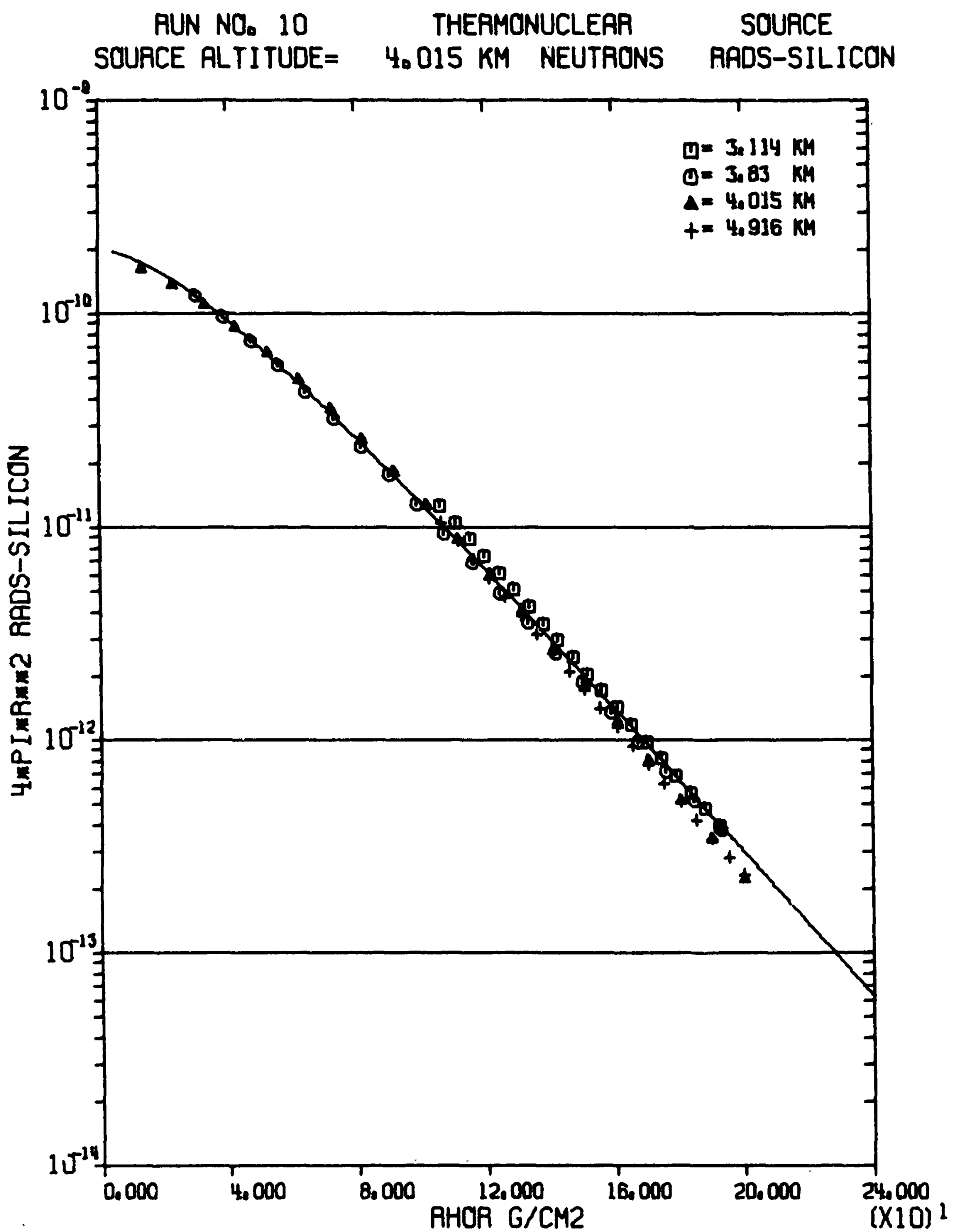


FIGURE C-49 NORSAIR FIT DATA-4PIR**2 NEUTRON SI DOSE, THERMONUCL SOURCE IN HOMO AIR AT 4.0 KM. ALL SAMPLING ALTITUDES

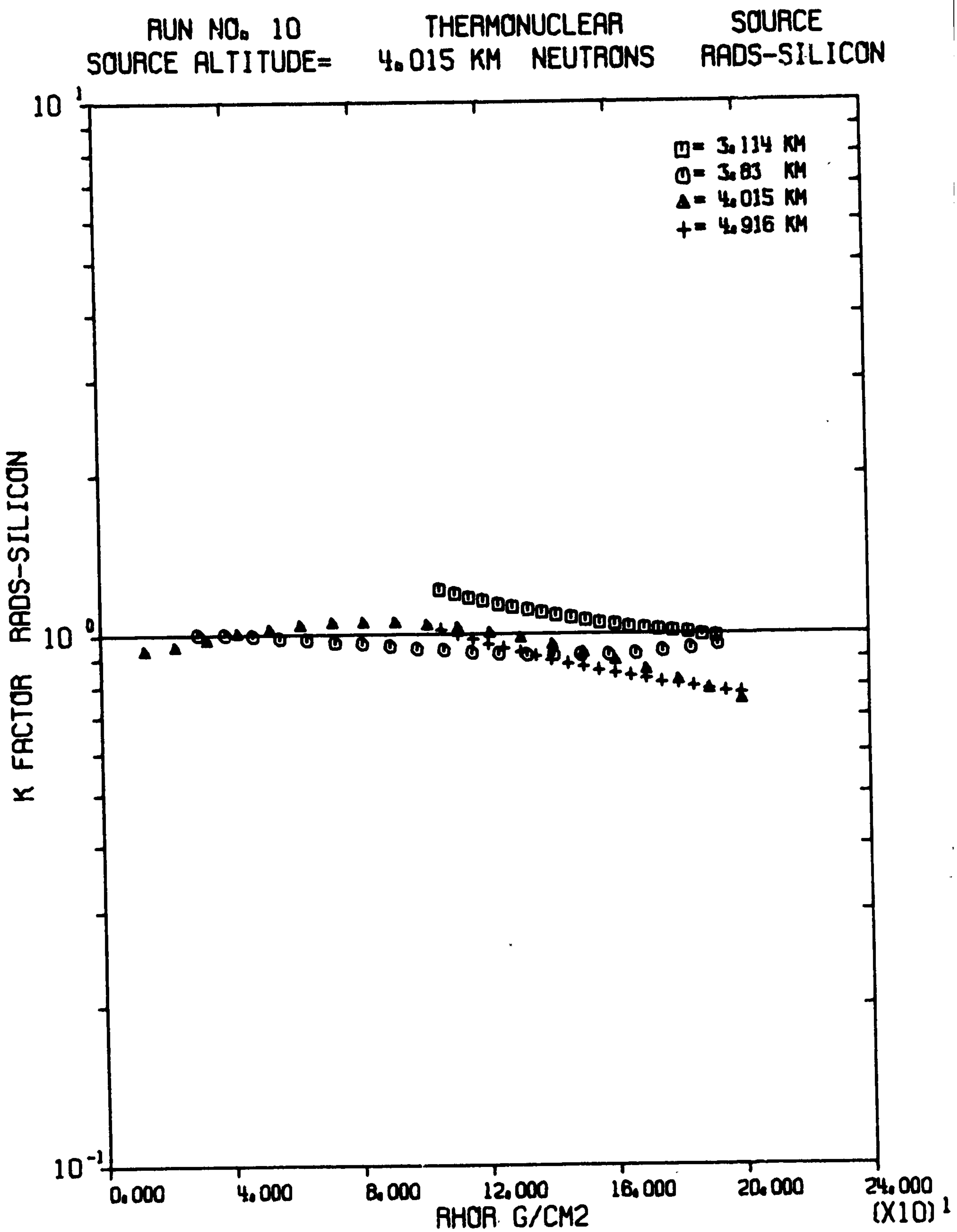


FIGURE C-50 MORSAIR FIT DATA-NEUTRON SILICON K-FACTOR THERMONUCL SOURCE IN HOMO AIR AT 4.0 KM. ALL SAMPLING ALTITUDES

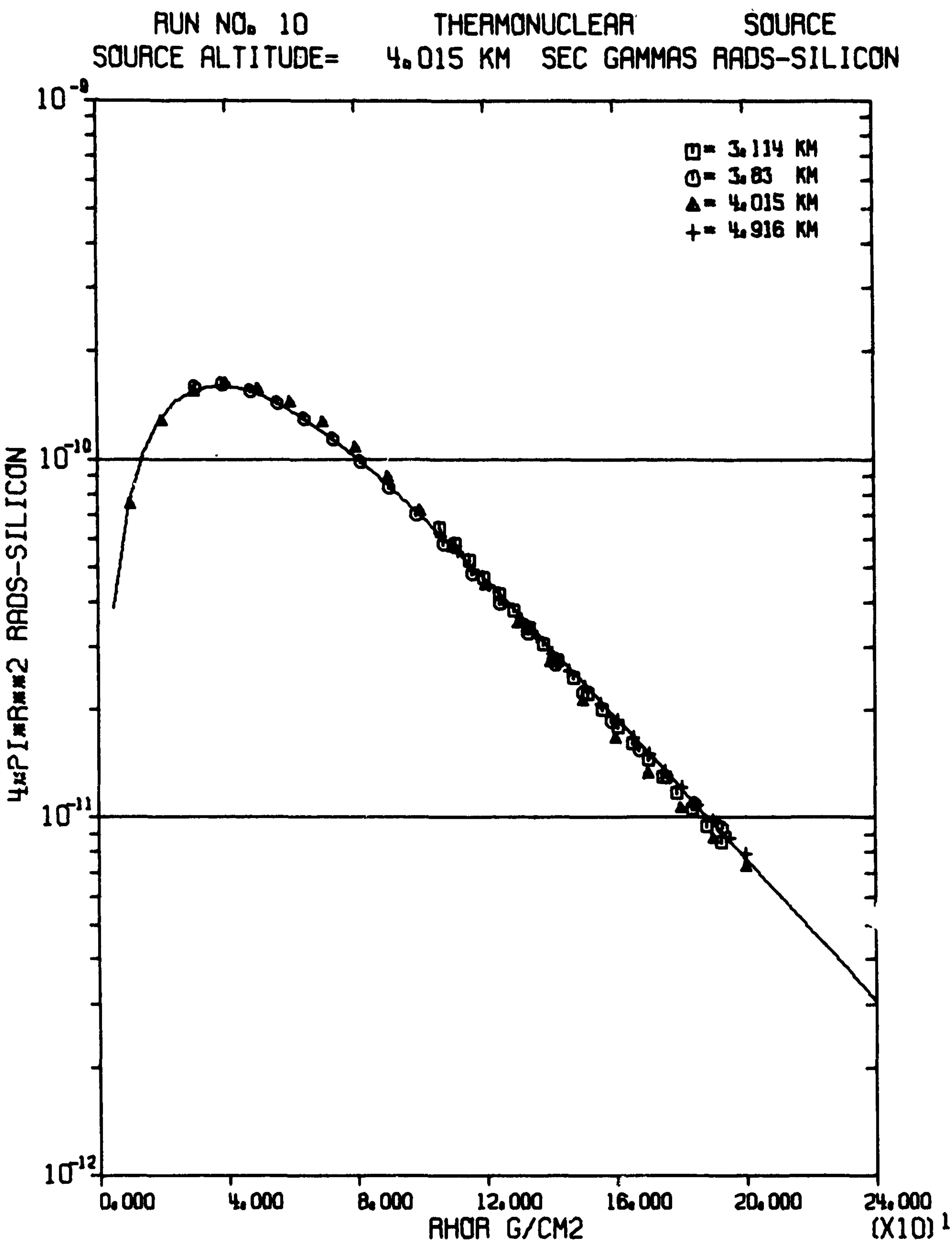


FIGURE C-51 MOKSAIK FIT DATA-4PIR**2 GAMMA SI DOSE,
THERMONUCL SOURCE IN HOMO AIR AT 4.0 KM.
ALL SAMPLING ALTITUDES

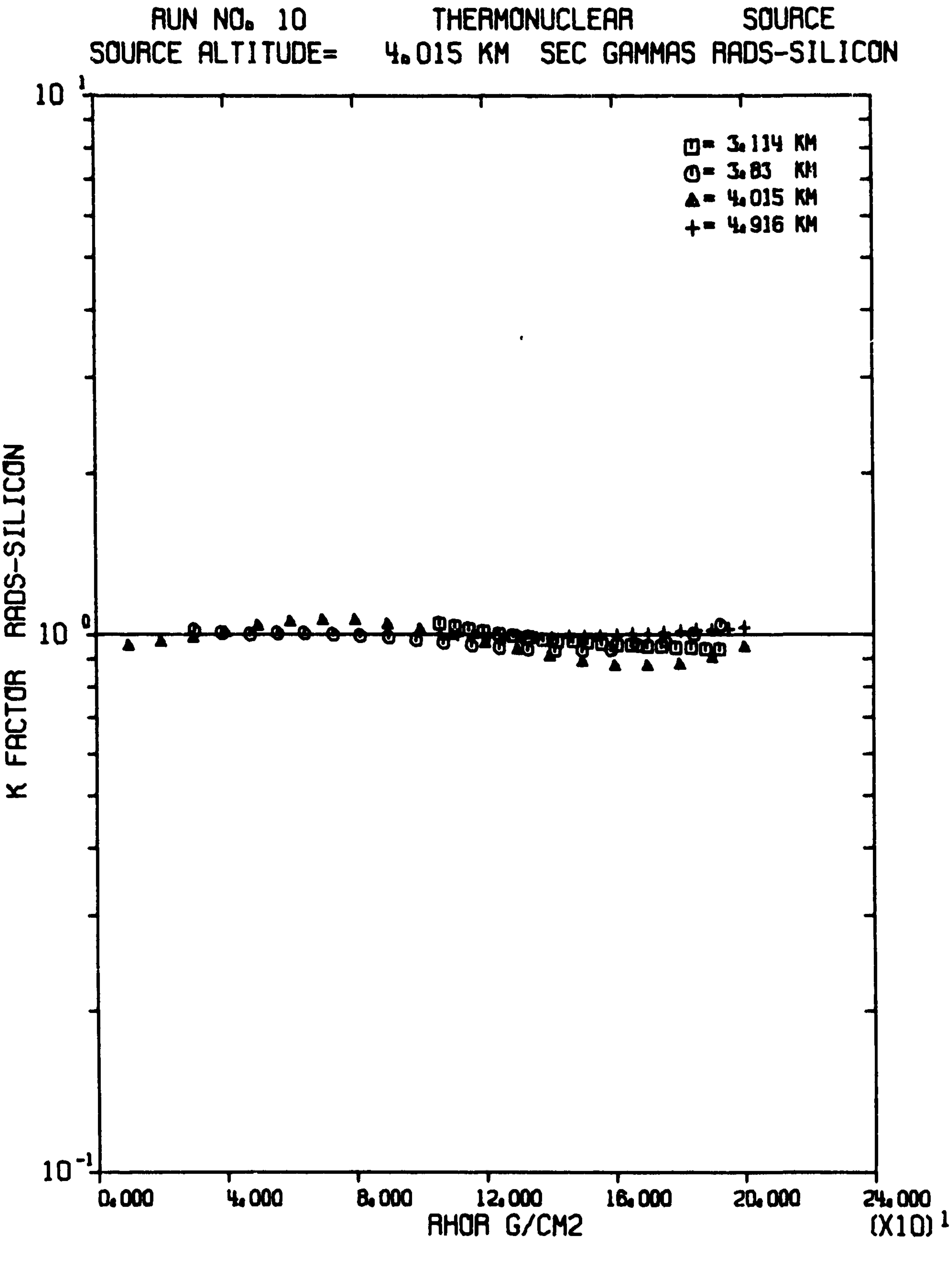


FIGURE C-52 MORSAIR FIT DATA-GAMMA SILICON K-FACTOR, THERMONUCL SOURCE IN HOMO AIR AT 4.0 KM. ALL SAMPLING ALTITUDES

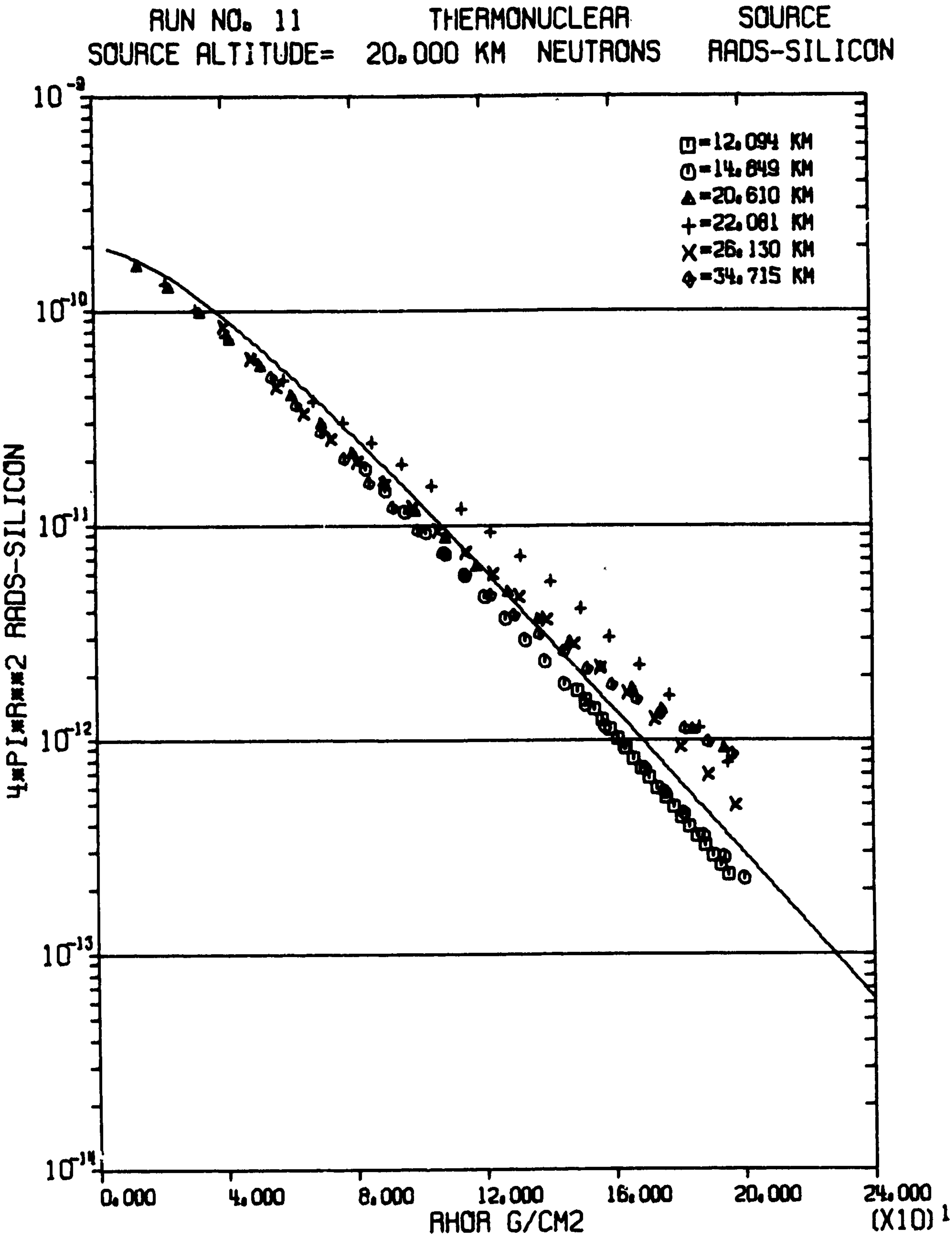


FIGURE 5-53 MORSAIR FIT DATA-4PIR**2 NEUTRON SI DOSE, THERMONUCL SOURCE IN REAL AIR AT 20.0 KM. ALL SAMPLING ALTITUDES

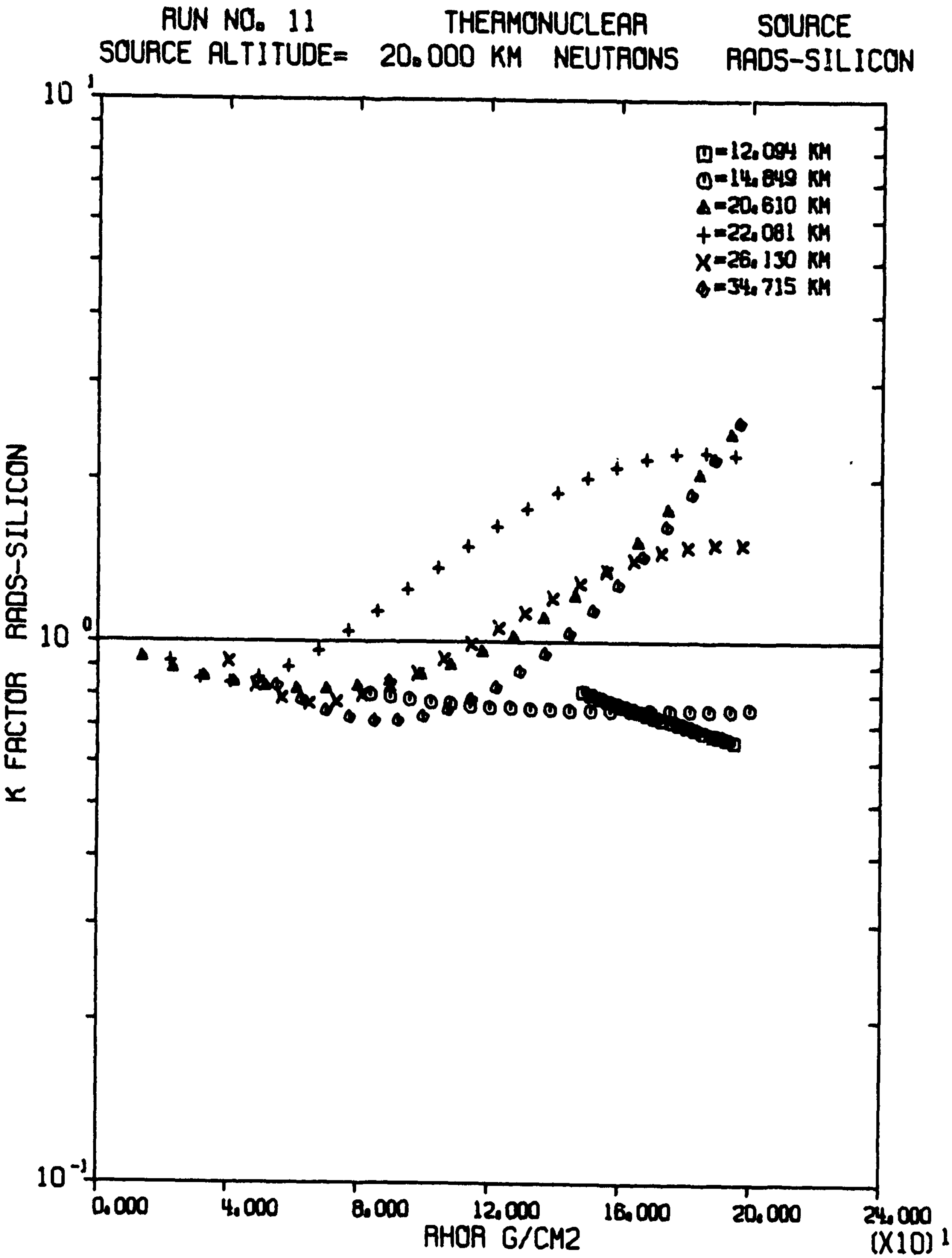


FIGURE C-54 MORSAIR FIT DATA-NEUTRON SILICON K-FACTOR
THERMONUCL SOURCE IN REAL AIR AT 20.0 KM.
ALL SAMPLING ALTITUDES

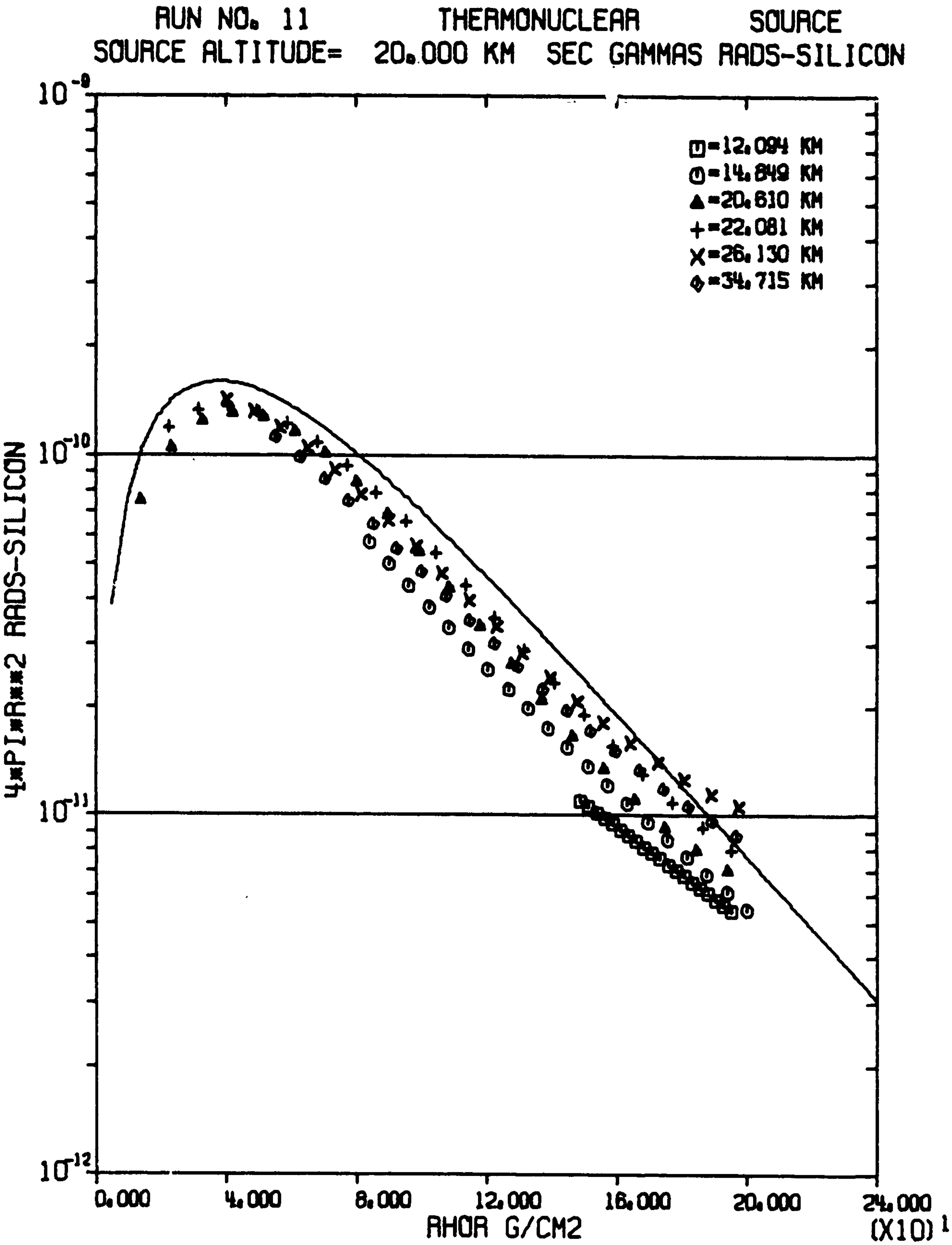


FIGURE C-55 MORSAIR FIT DATA-4PIR**2 GAMMA SI DOSE, THERMONUCL SOURCE IN REAL AIR AT 20.0 KM. ALL SAMPLING ALTITUDES

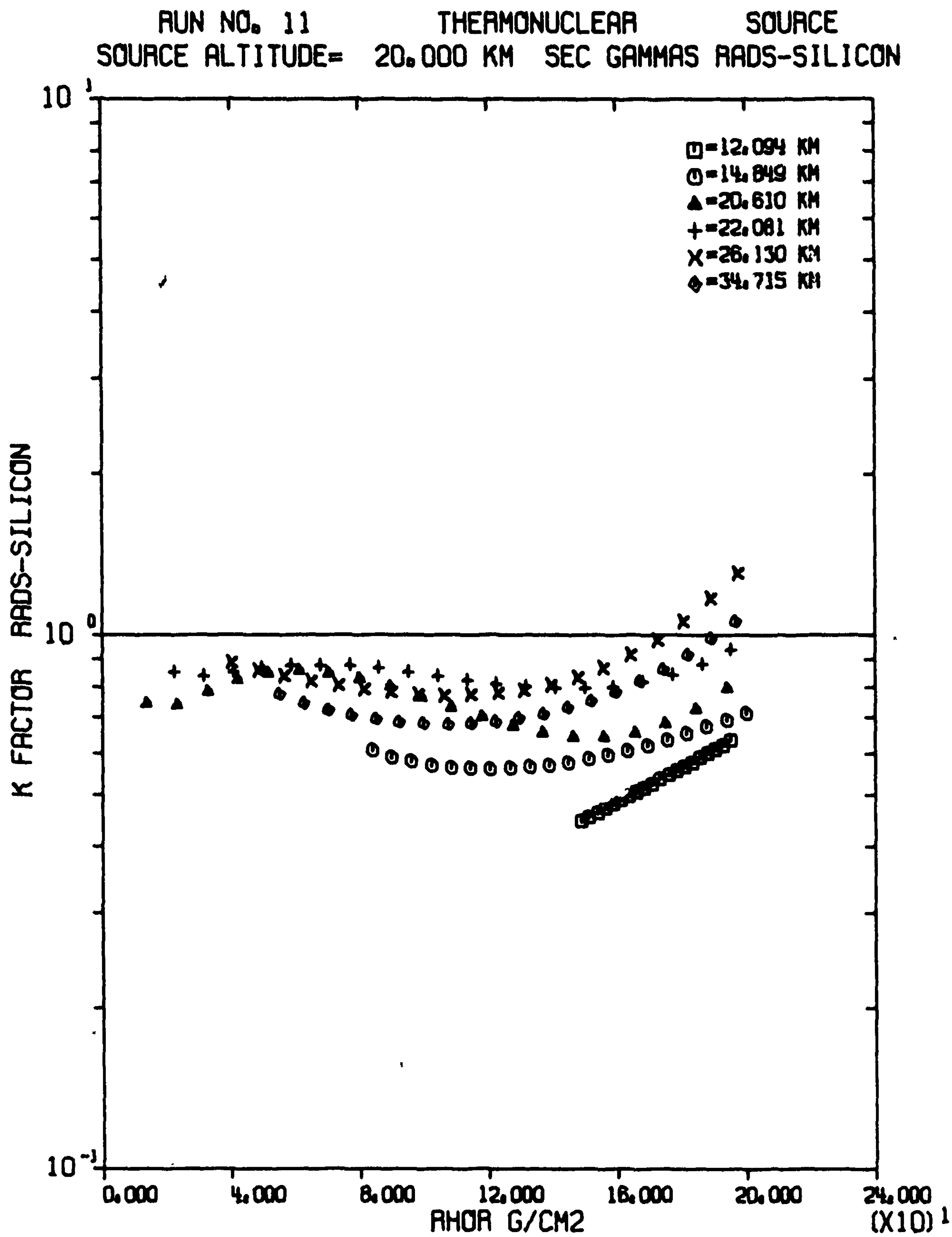


FIGURE C-56 NORSAIR FIT DATA-GAMMA SILICON K-FACTOR, THERMONUCL SOURCE IN REAL AIR AT 20.0 KM. ALL SAMPLING ALTITUDES

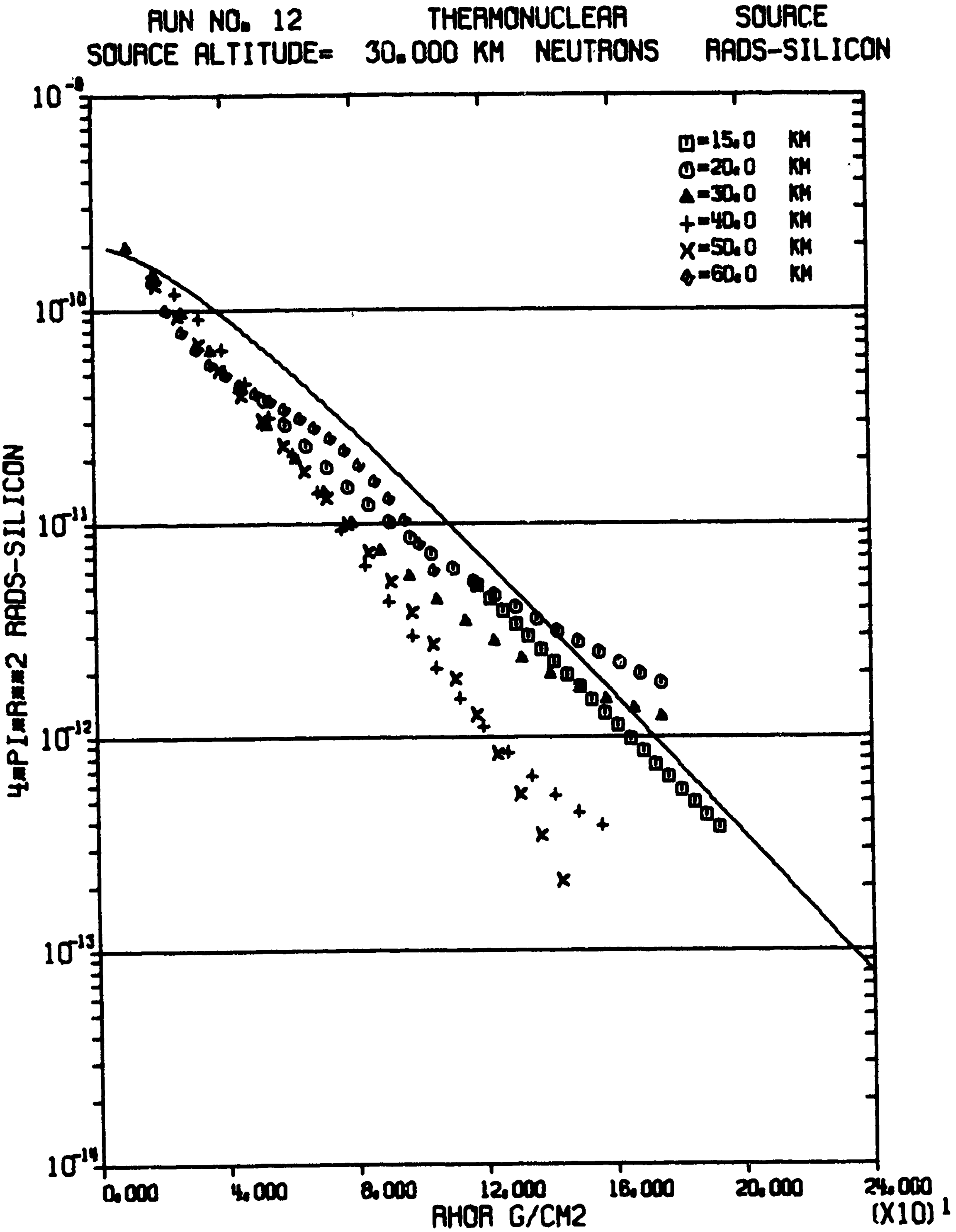


FIGURE 3-57 MORSAIR FIT DATA-4PIR**2 NEUTRON SI DOSE, THERMONUCL SOURCE IN REAL AIR AT 30.0 KM. ALL SAMPLING ALTITUDES

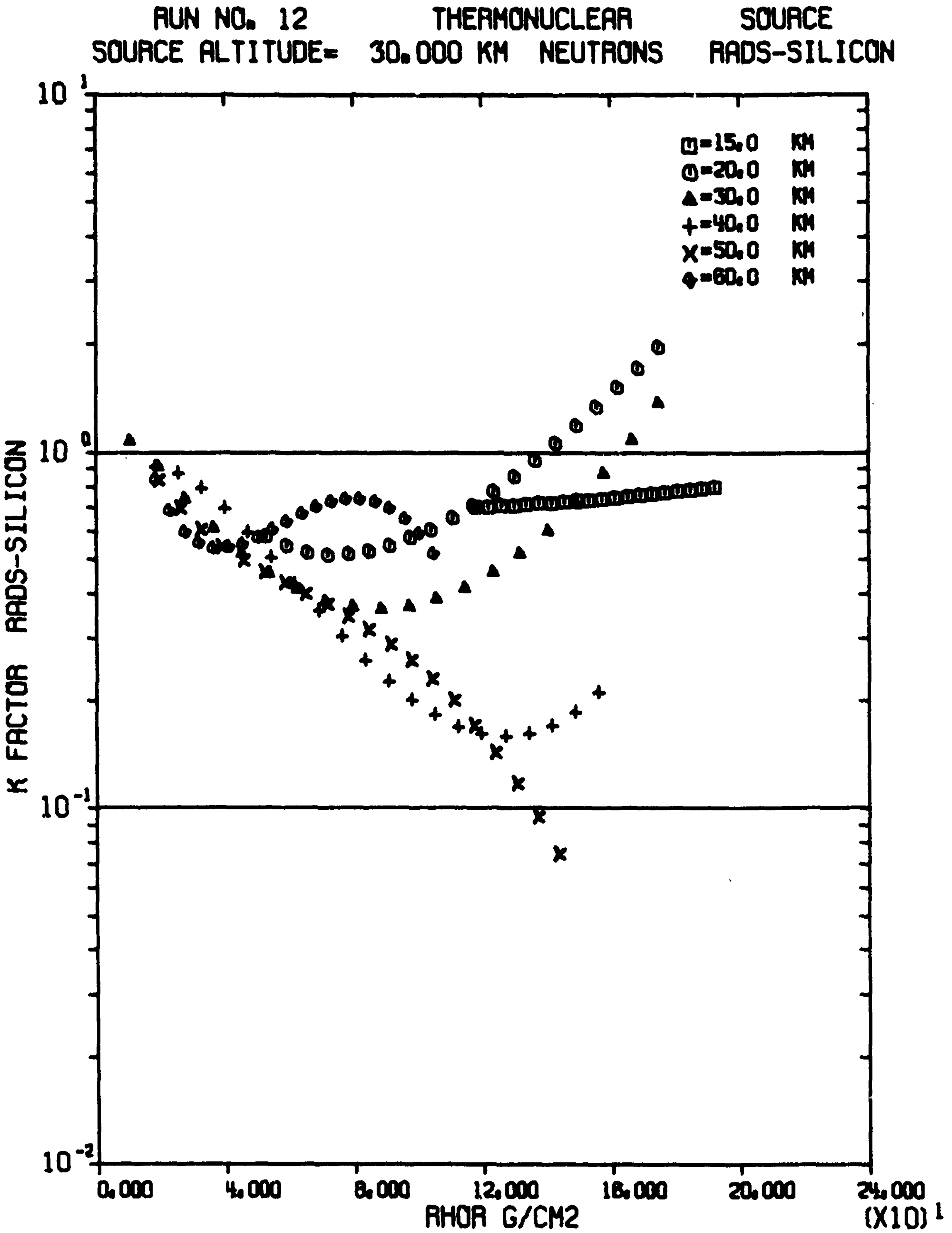


FIGURE C-58 40KSAIR FIT DATA-NEUTRON SILICON K-FACTOR
THERMONUCL SOURCE IN REAL AIR AT 30.0 KM.
ALL SAMPLING ALTITUDES

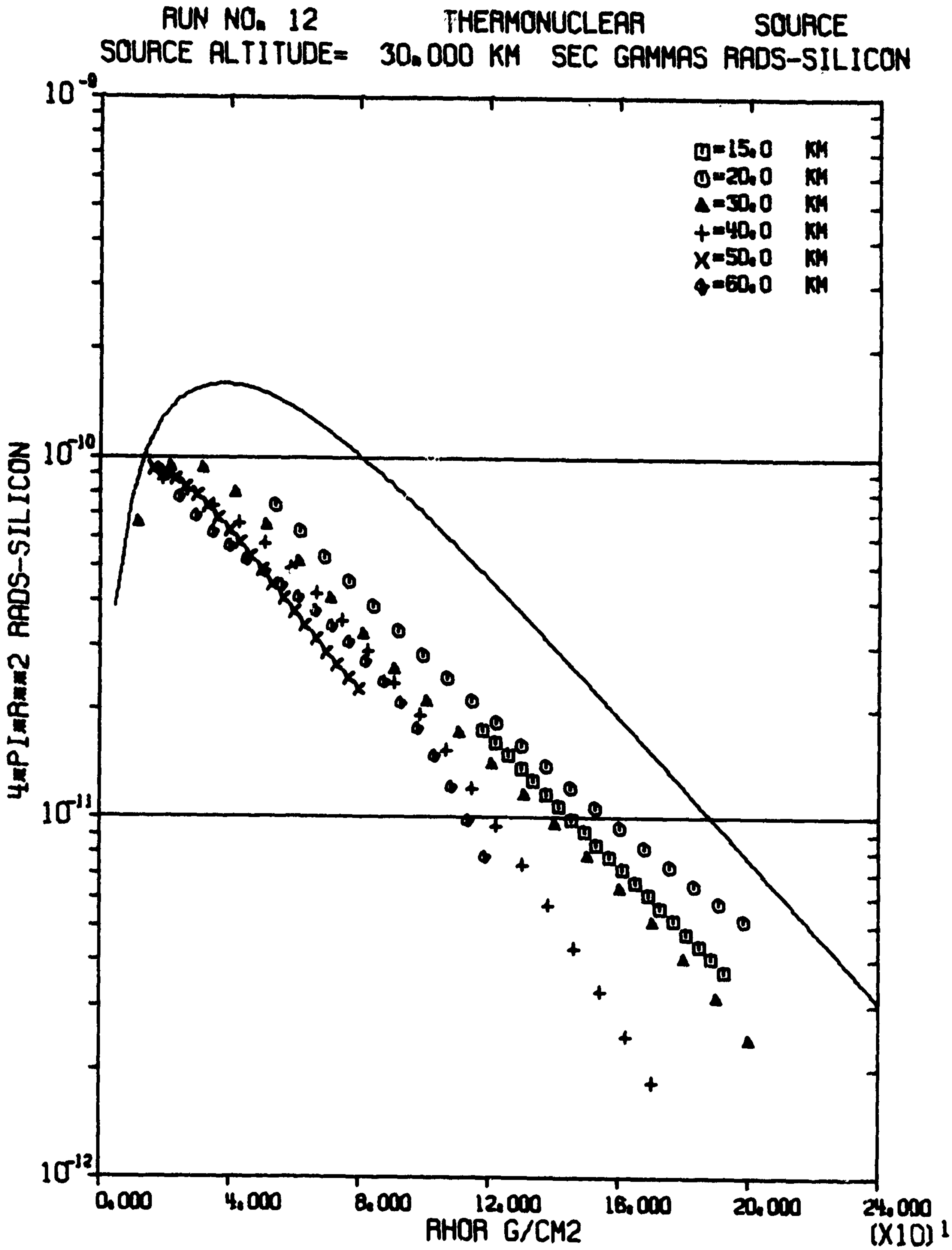
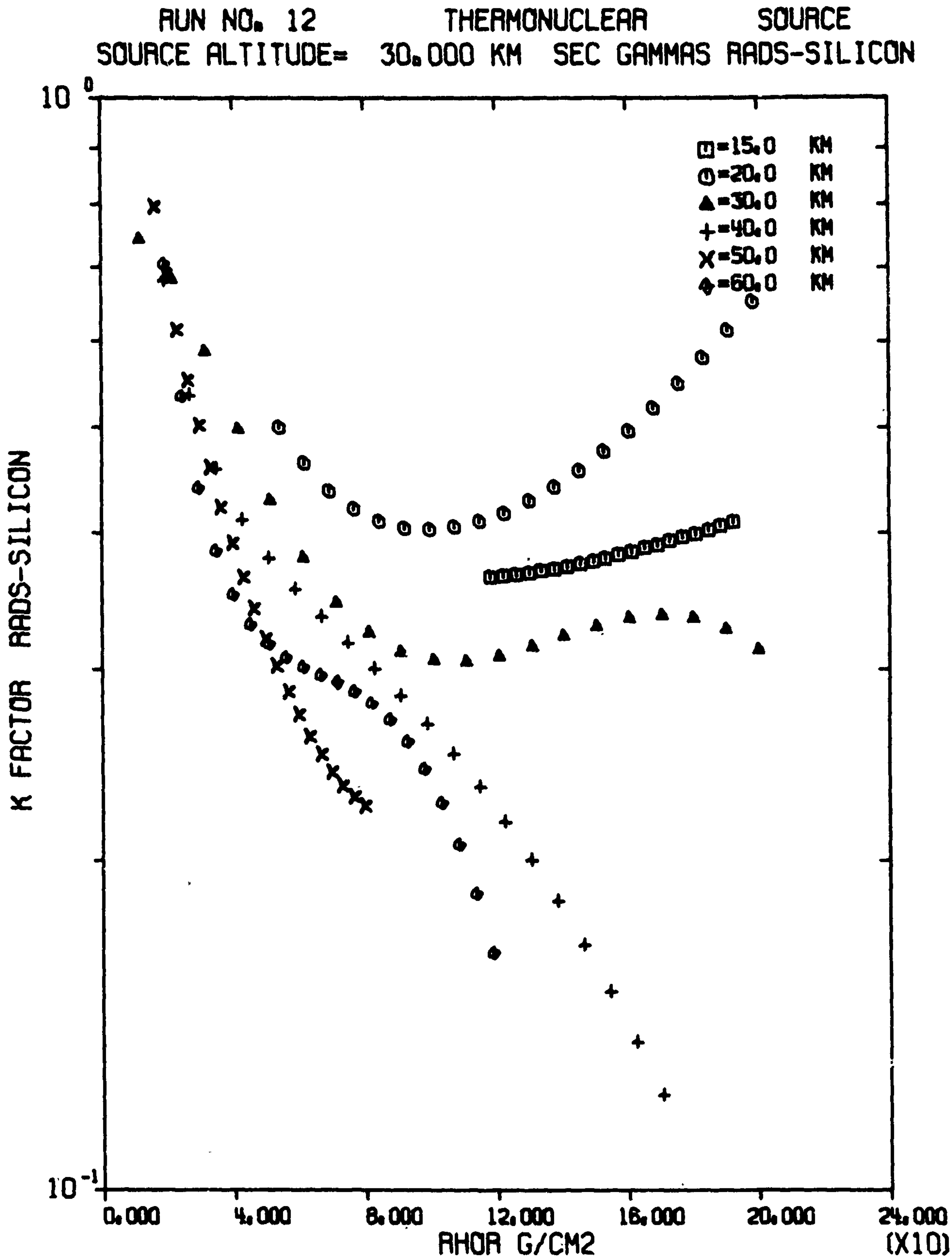


FIGURE 6-59 MORSAIR FIT DATA-4PIR**2 GAMMA SI DOSE, THERMONUCL SOURCE IN REAL AIR AT 30.0 KM. ALL SAMPLING ALTITUDES



FIGU ?-6C MORSAIR FIT DATA-GAMMA SILICON K-FACTOR, THERMONUCL SOURCE IN REAL AIR AT 30.0 KM. ALL SAMPLING ALTITUDES

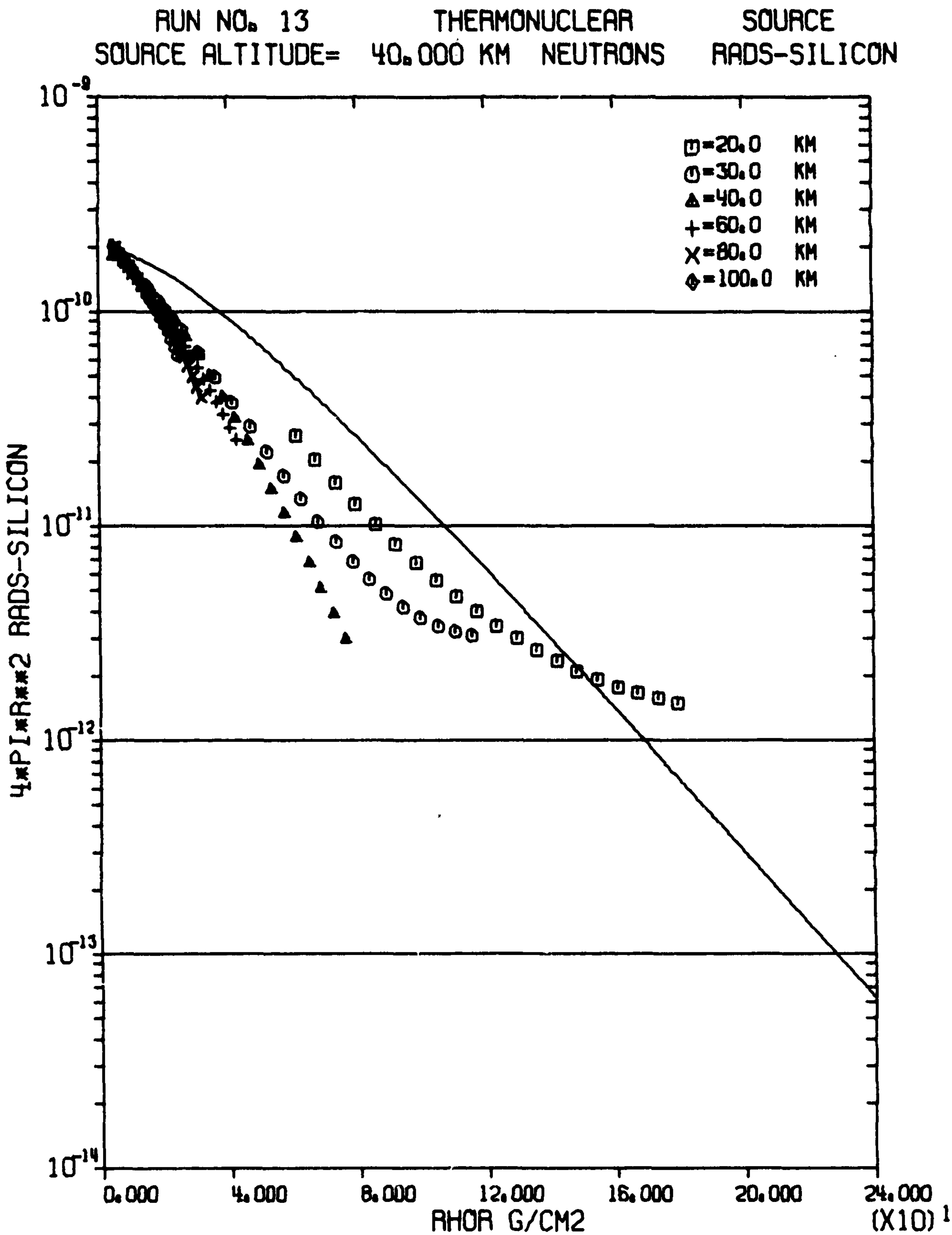


FIGURE 6-61 MORSAIR FIT DATA-4PIR**2 NEUTRON SI DOSE, THERMONUCL SOURCE IN REAL AIR AT 40.0 KM. ALL SAMPLING ALTITUDES

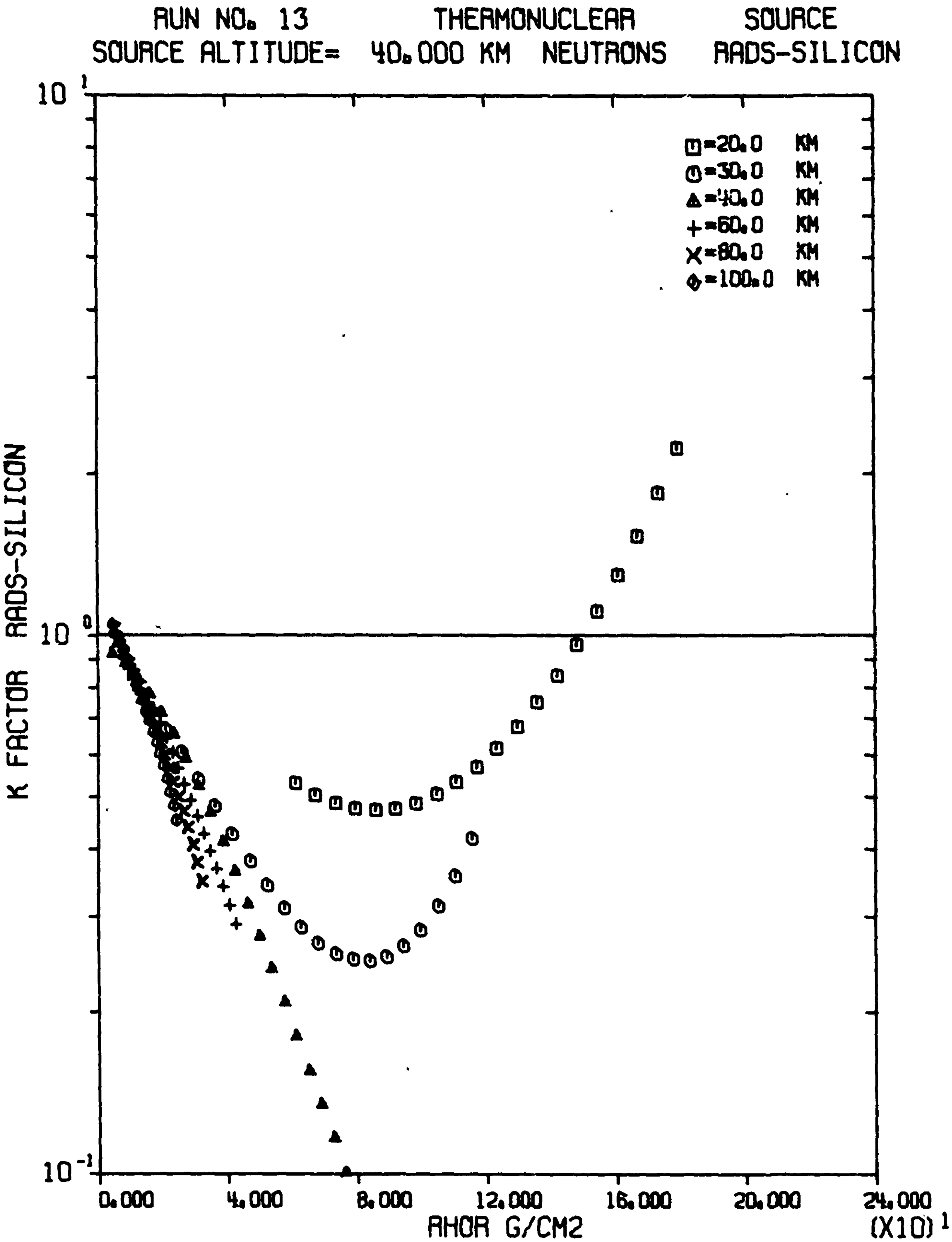


FIGURE 3-62 NORSAIR FIT DATA-NEUTRON SILICON K-FACTOR
THERMONUCL SOURCE IN REAL AIR AT 40.0 KM.
ALL SAMPLING ALTITUDES

RUN NO. 13 THERMONUCLEAR SOURCE
SOURCE ALTITUDE= 40.000 KM SEC GAMMAS RADS-SILICON

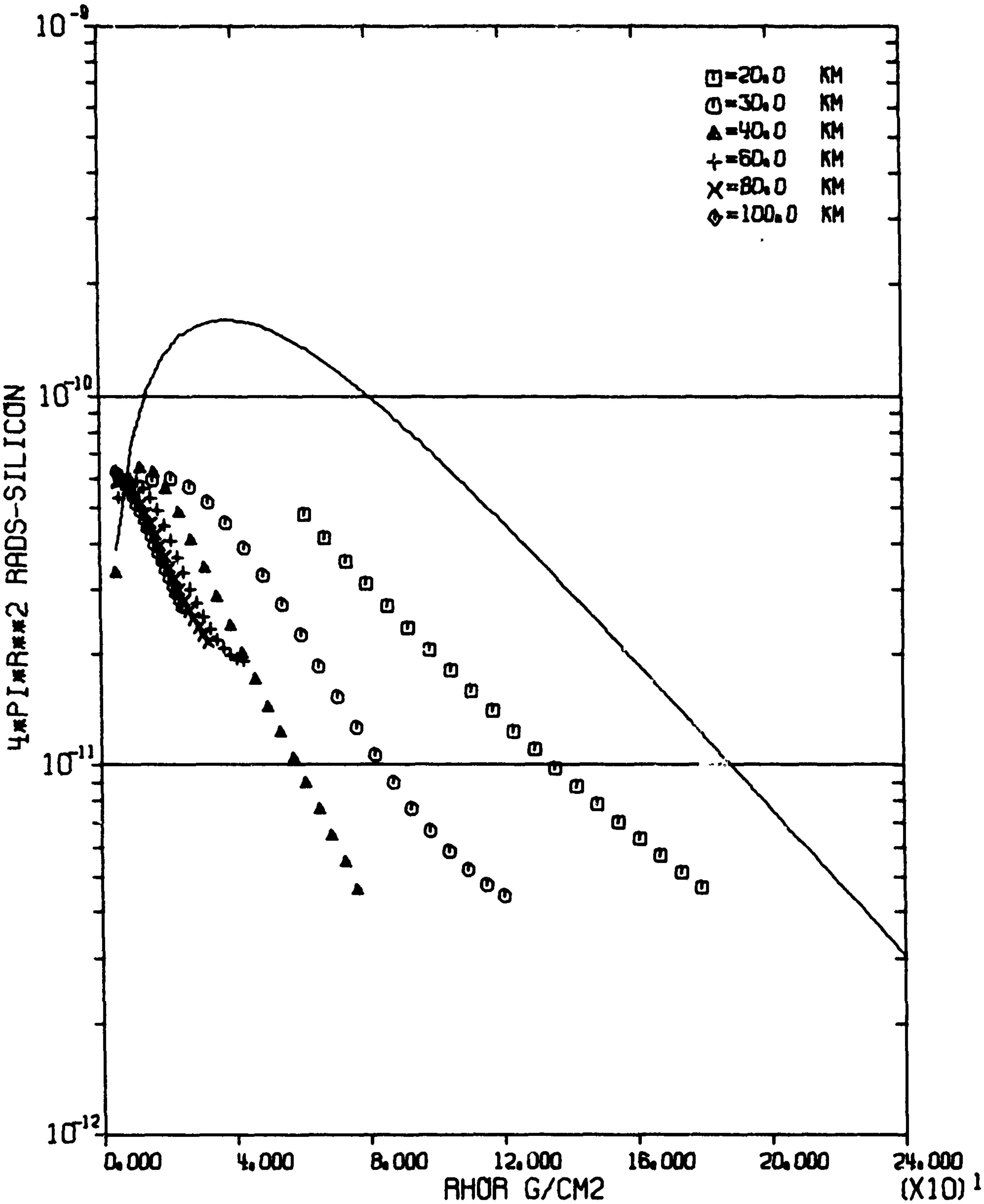


FIGURE C-63 MORSAIR FIT DATA-4PIR**2 GAMMA SI DOSE, THERMONUCL SOURCE IN REAL AIR AT 40.0 KM. ALL SAMPLING ALTITUDES

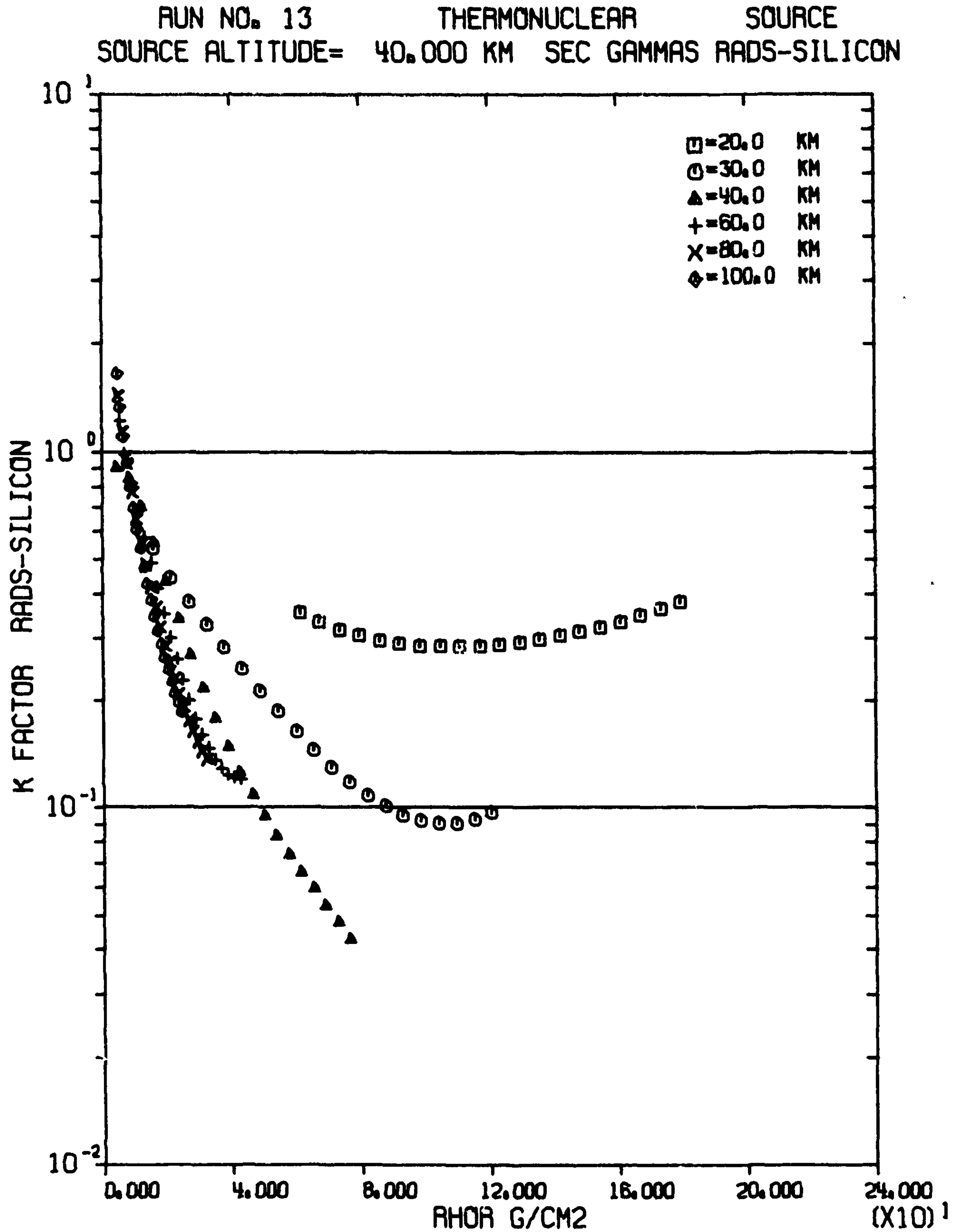


FIGURE C-64 MORSAIR FIT DATA-GAMMA SILICON K-FACTOR, THERMONUCL SOURCE IN REAL AIR AT 40.0 KM. ALL SAMPLING ALTITUDES

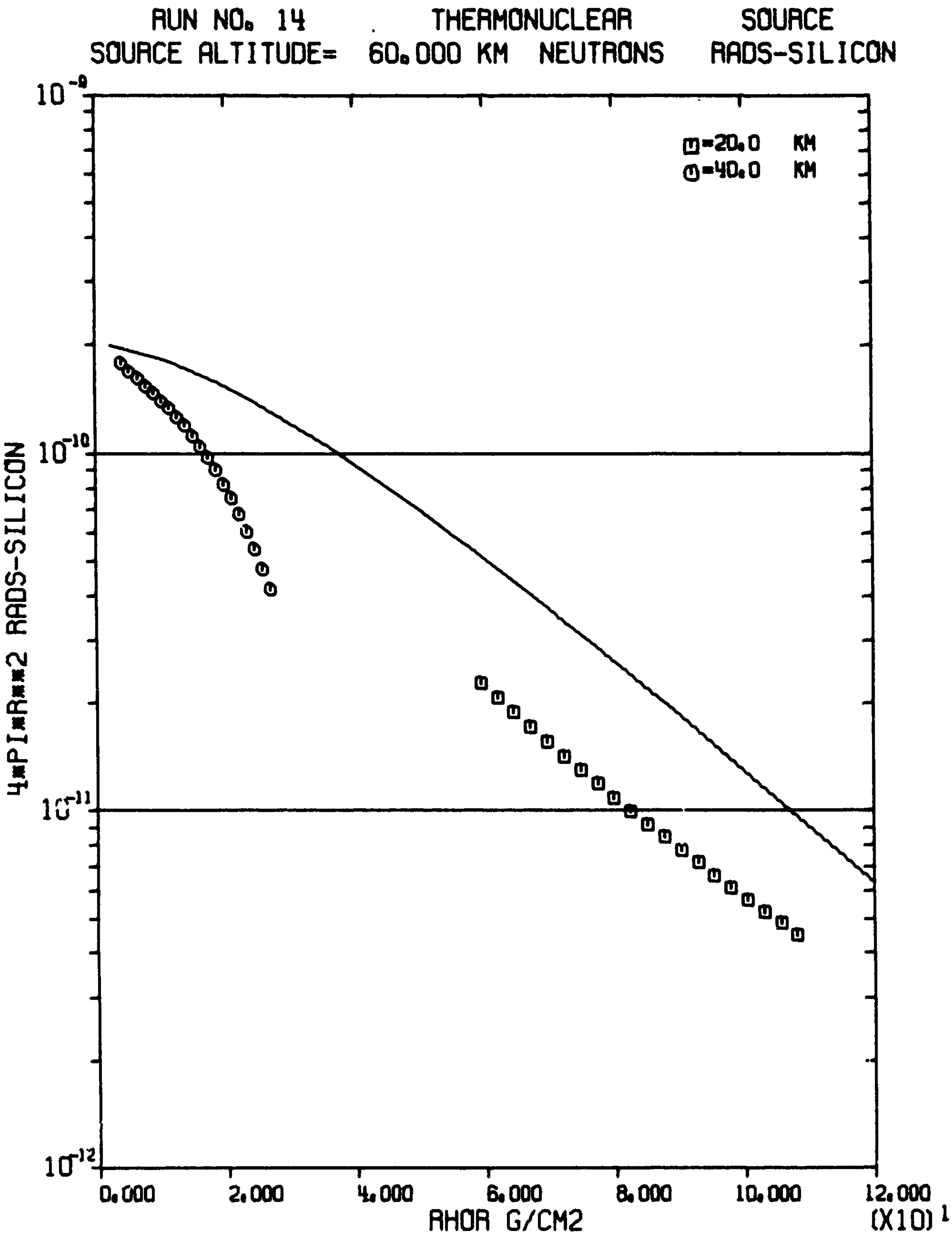


FIGURE C-65 MORSAIR FIT DATA-4PIR**2 NEUTRON SI DOSE, THERMONUCL SOURCE IN REAL AIR AT 60.0 KM. SAMPLING ALTITUDES 20 AND 40 KM.

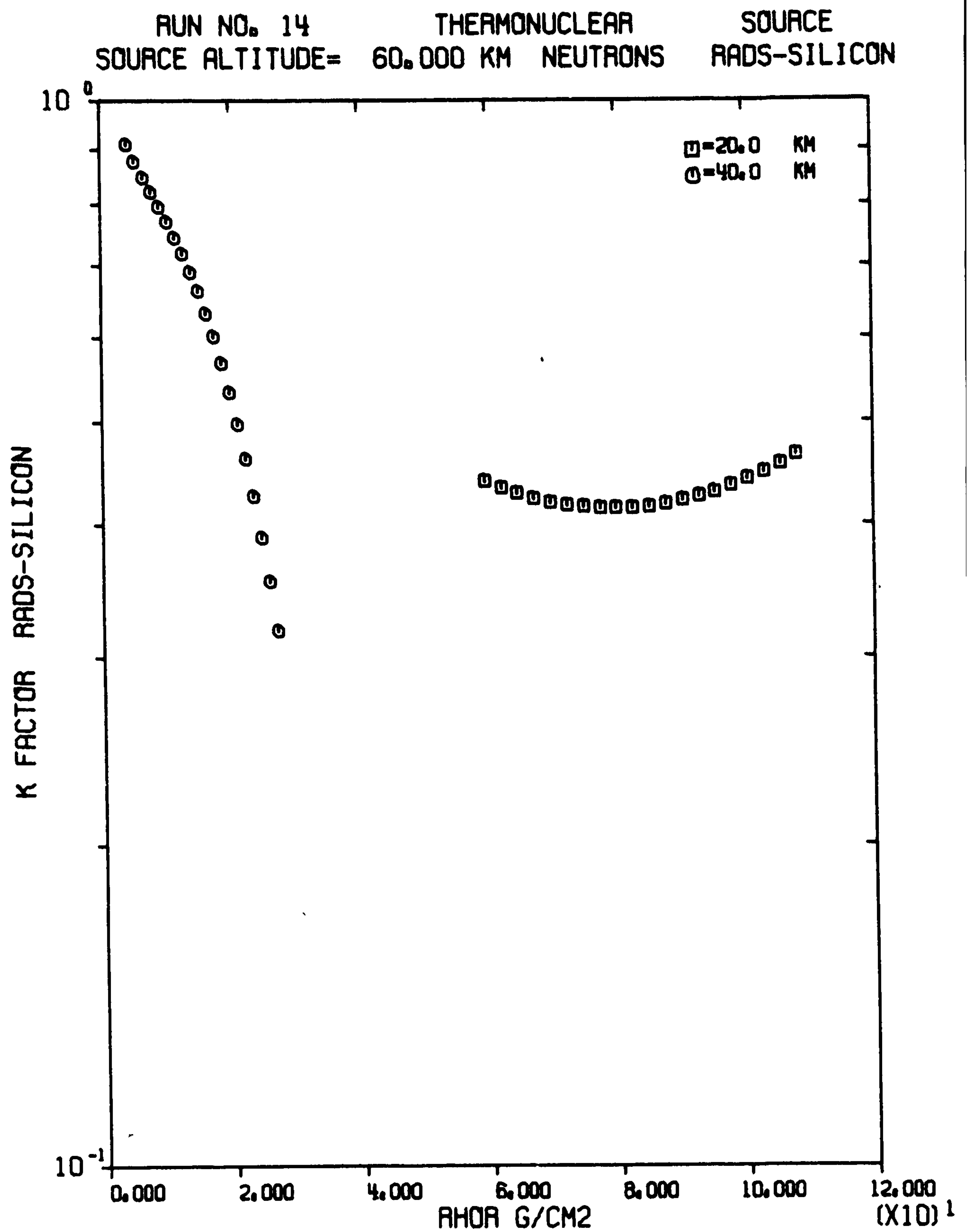


FIGURE C-66 MORSAIR FIT DATA-NEUTRON SILICON K-FACTOR THERMONUCL SOURCE IN REAL AIR AT 60.0 KM. SAMPLING ALTITUDES 20 AND 40 KM.

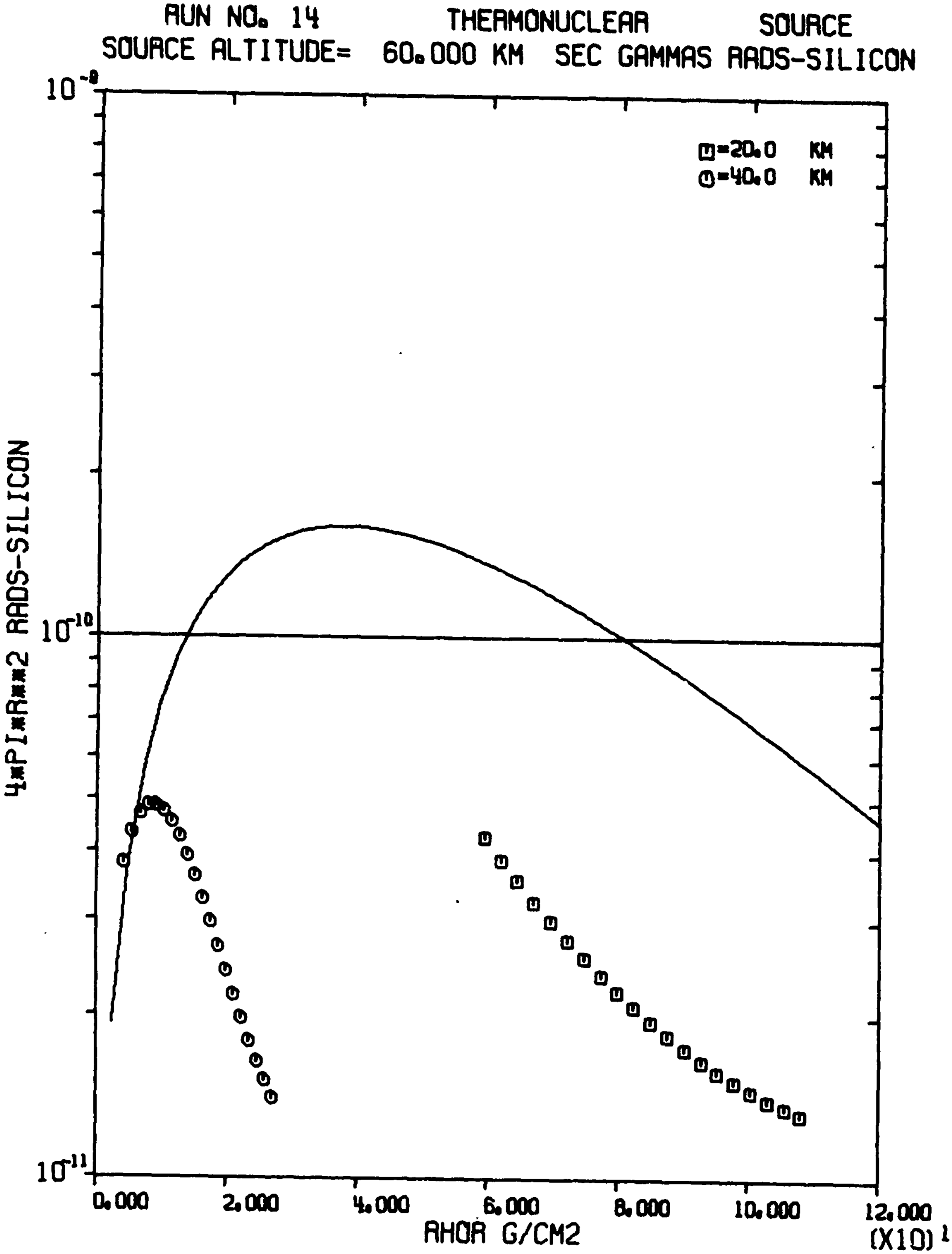


FIGURE C-67 MORSAIR FIT DATA-4PIR**2 GAMMA SI DOSE, THERMONUCL SOURCE IN REAL AIR AT 60.0 KM. SAMPLING ALTITUDES 20 AND 40 KM.

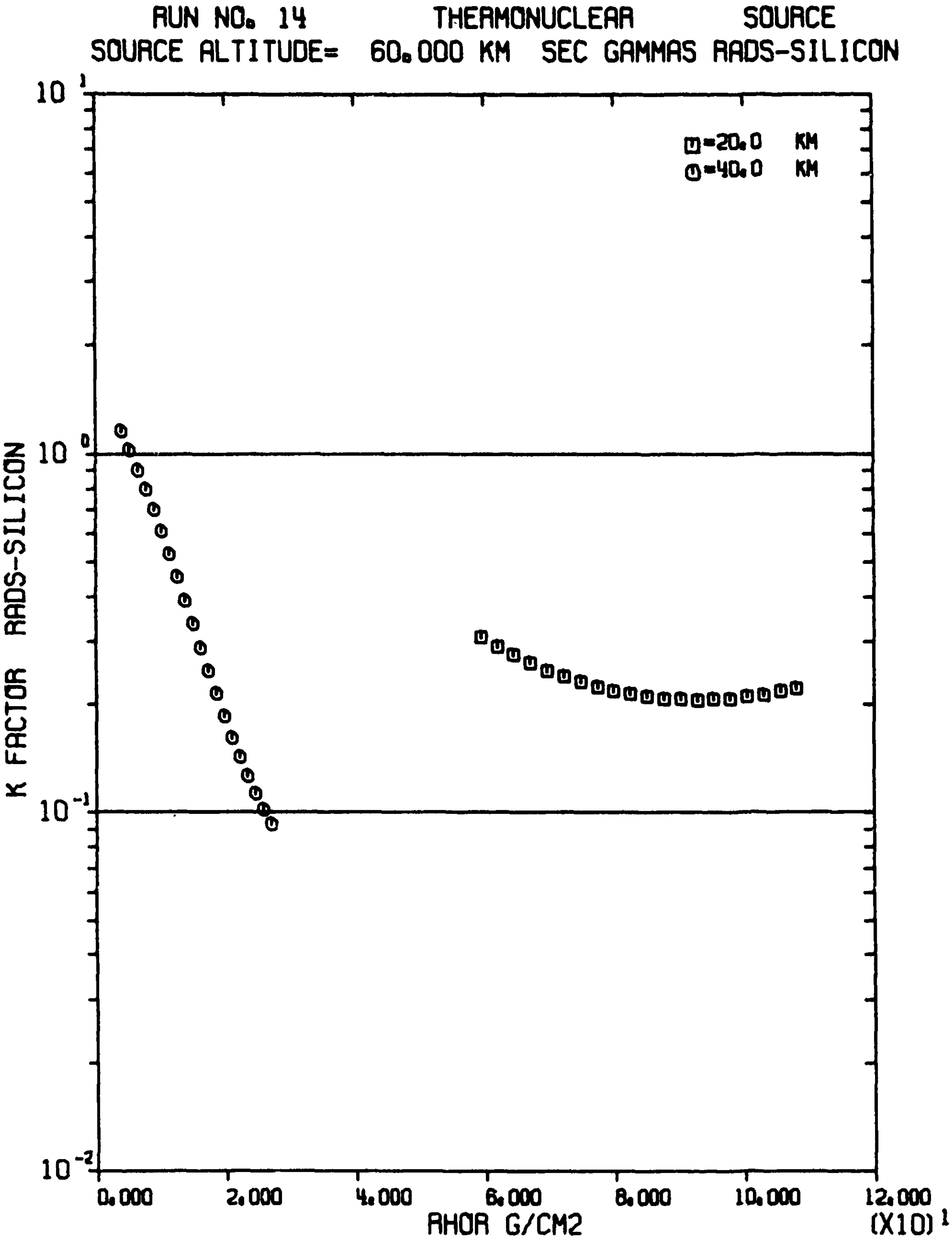


FIGURE C-68 MORSAIR FIT DATA-GAMMA SILICON K-FACTOR, THERMONUCL SOURCE IN REAL AIR AT 60.0 KM. SAMPLING ALTITUDES 20 AND 40 KM.

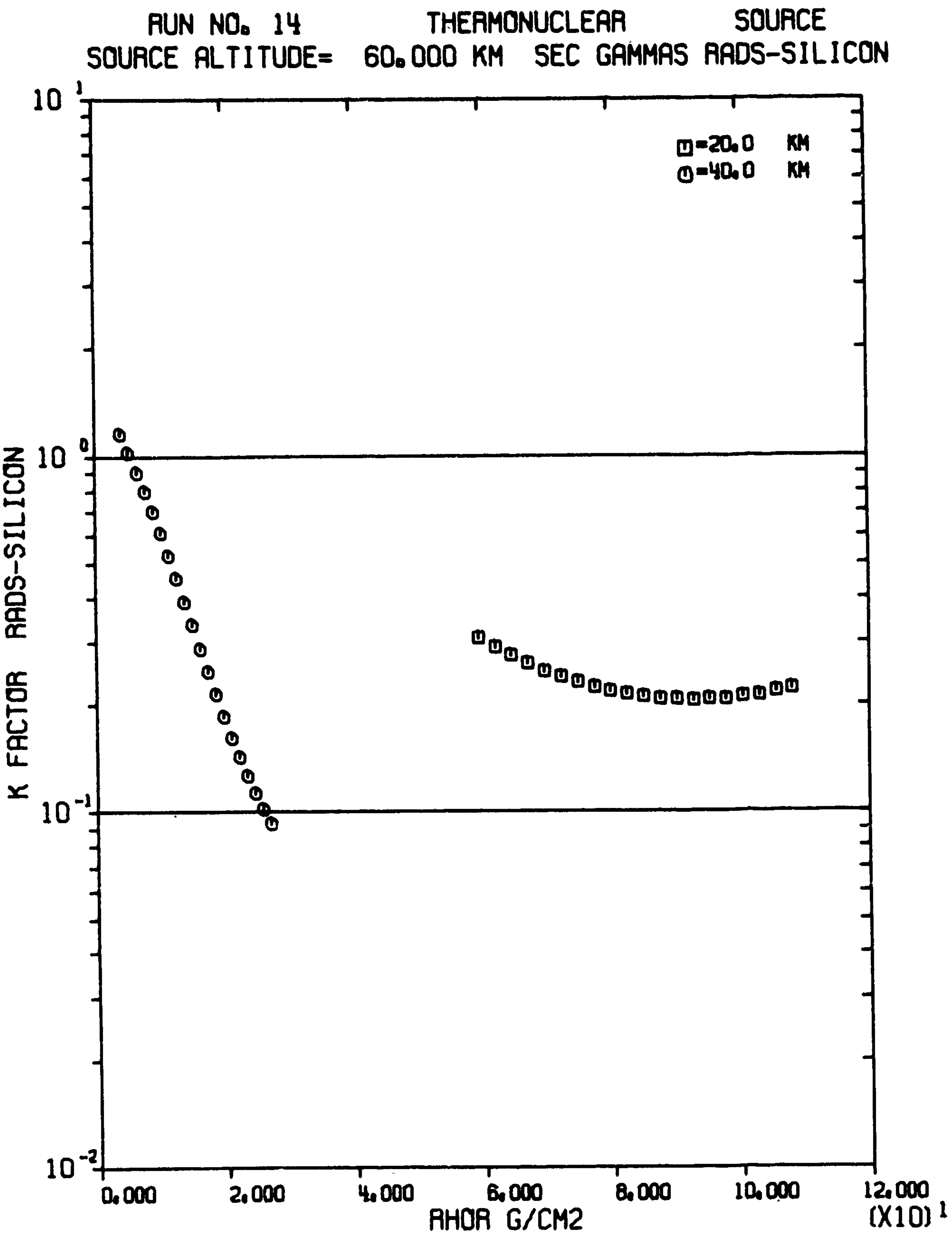


FIGURE C-68 MORSAIR FIT DATA-GAMMA SILICON K-FACTOR, THERMONUCL SOURCE IN REAL AIR AT 60.0 KM. SAMPLING ALTITUDES 20 AND 40 KM.

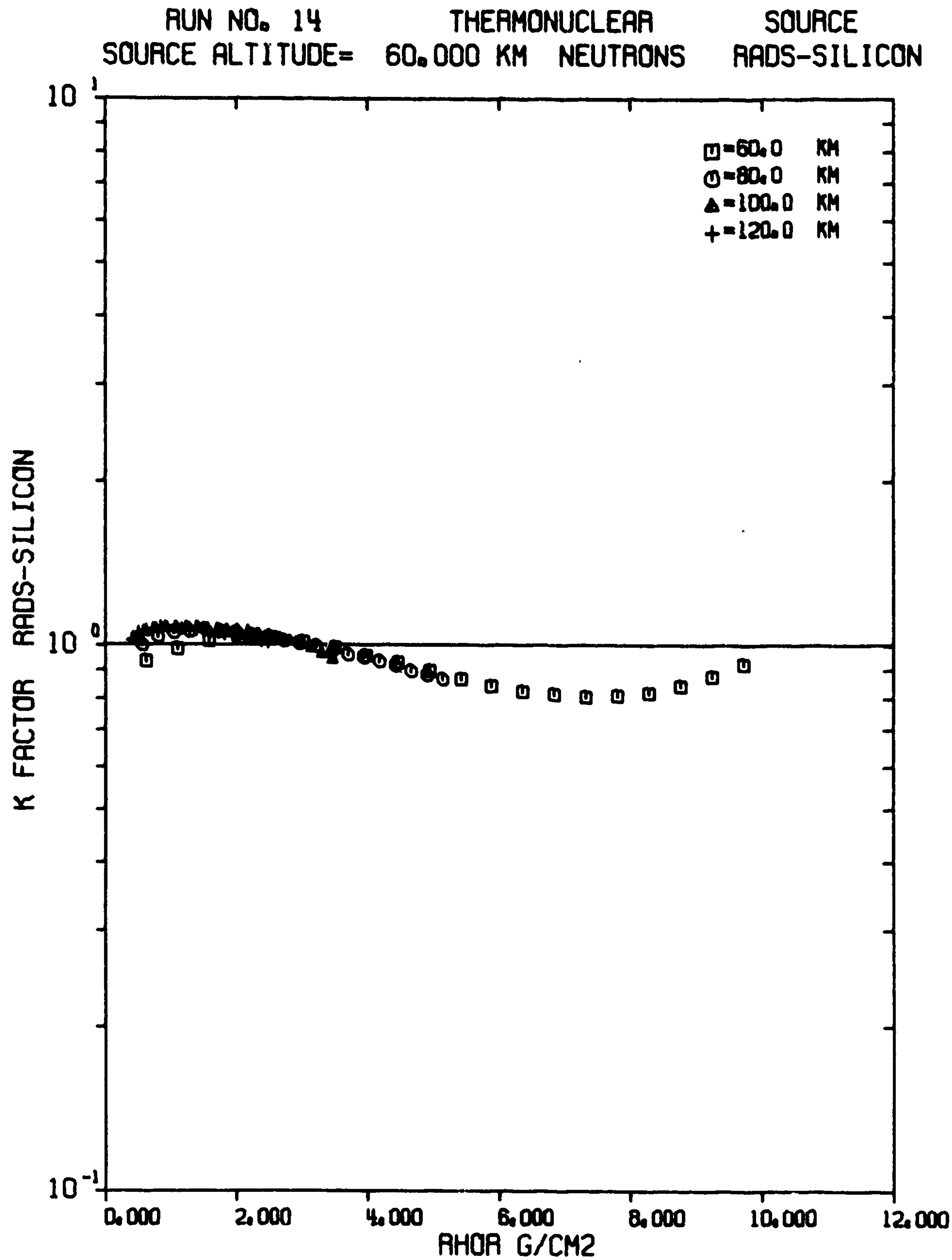


FIGURE C-70 MORSAIR FIT DATA-NEUTRON SILICON K-FACTOR THERMONUCL SOURCE IN REAL AIR AT 60.0 KM. SAMPLING ALTITUDES 60,80,100, AND 120 KM.

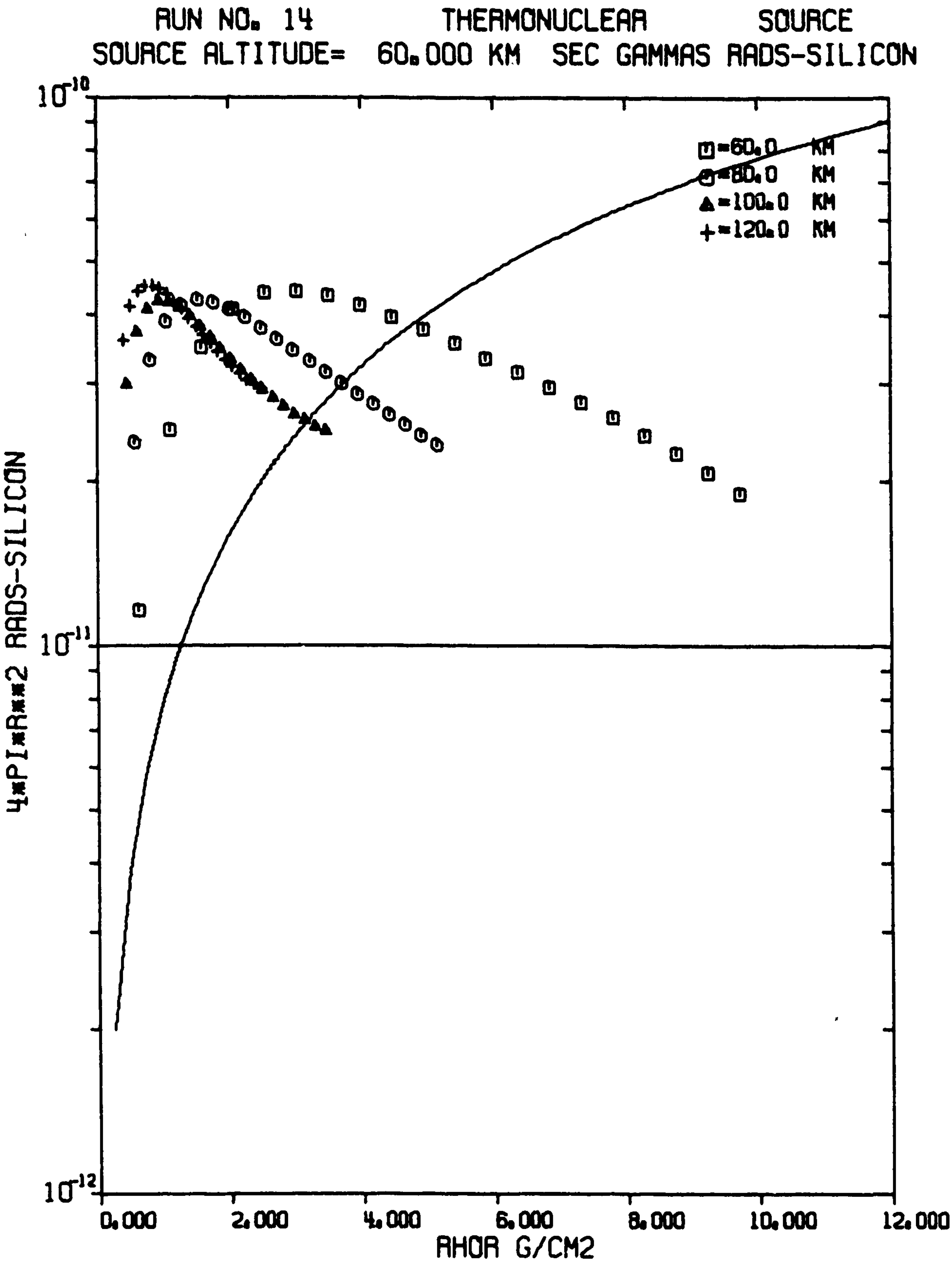


FIGURE C-71 MORSAIR FIT DATA-4PIR**2 GAMMA SI DOSE, THERMONUCL SOURCE IN REAL AIR AT 60.0 KM. SAMPLING ALTITUDES 60,80,100, AND 120 KM.

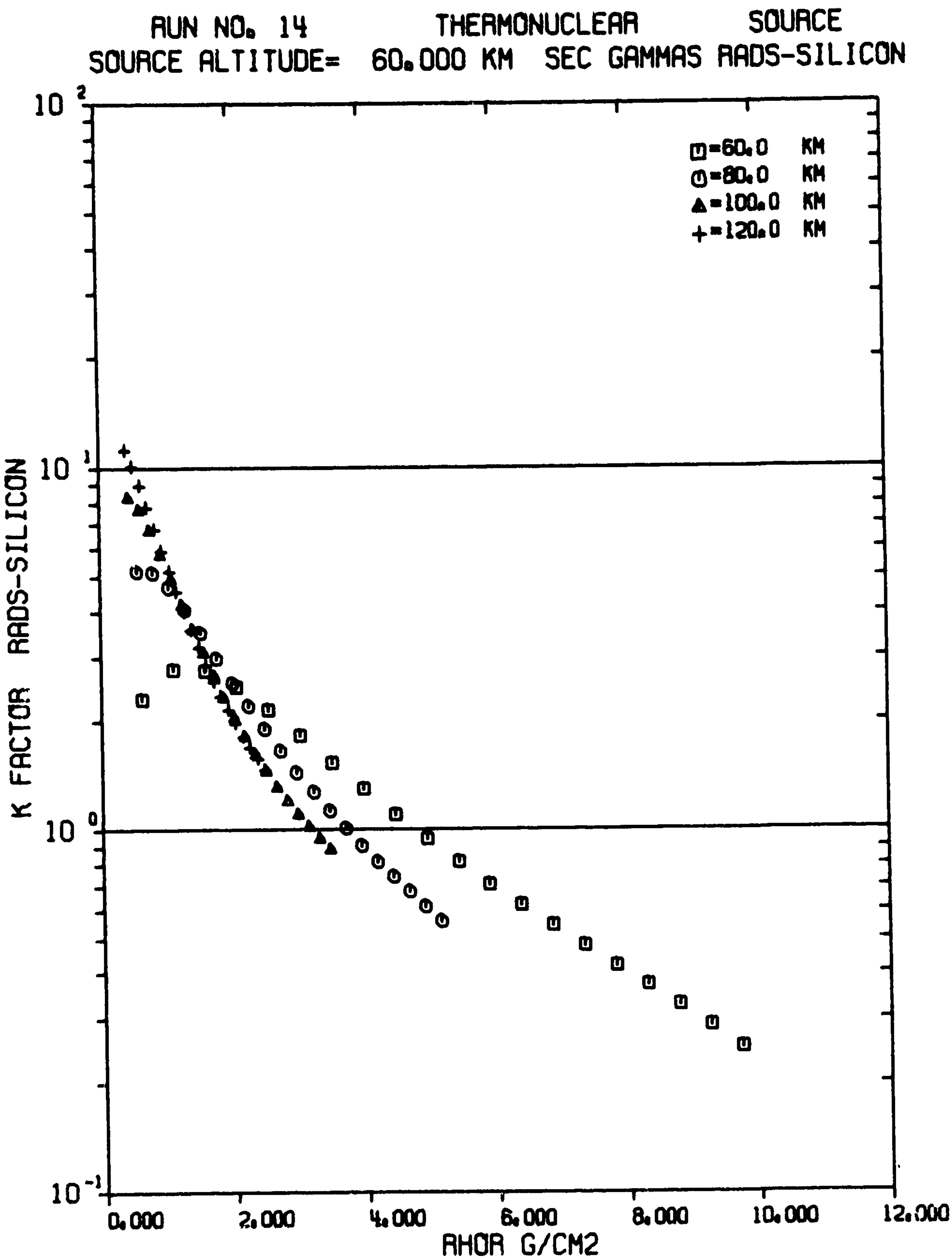


FIGURE C-72 MORSAIR FIT DATA-GAMMA SILICON K-FACTOR, THERMONUCL SOURCE IN REAL AIR AT 60.0 KM. SAMPLING ALTITUDES 60,80,100, AND 120 KM.

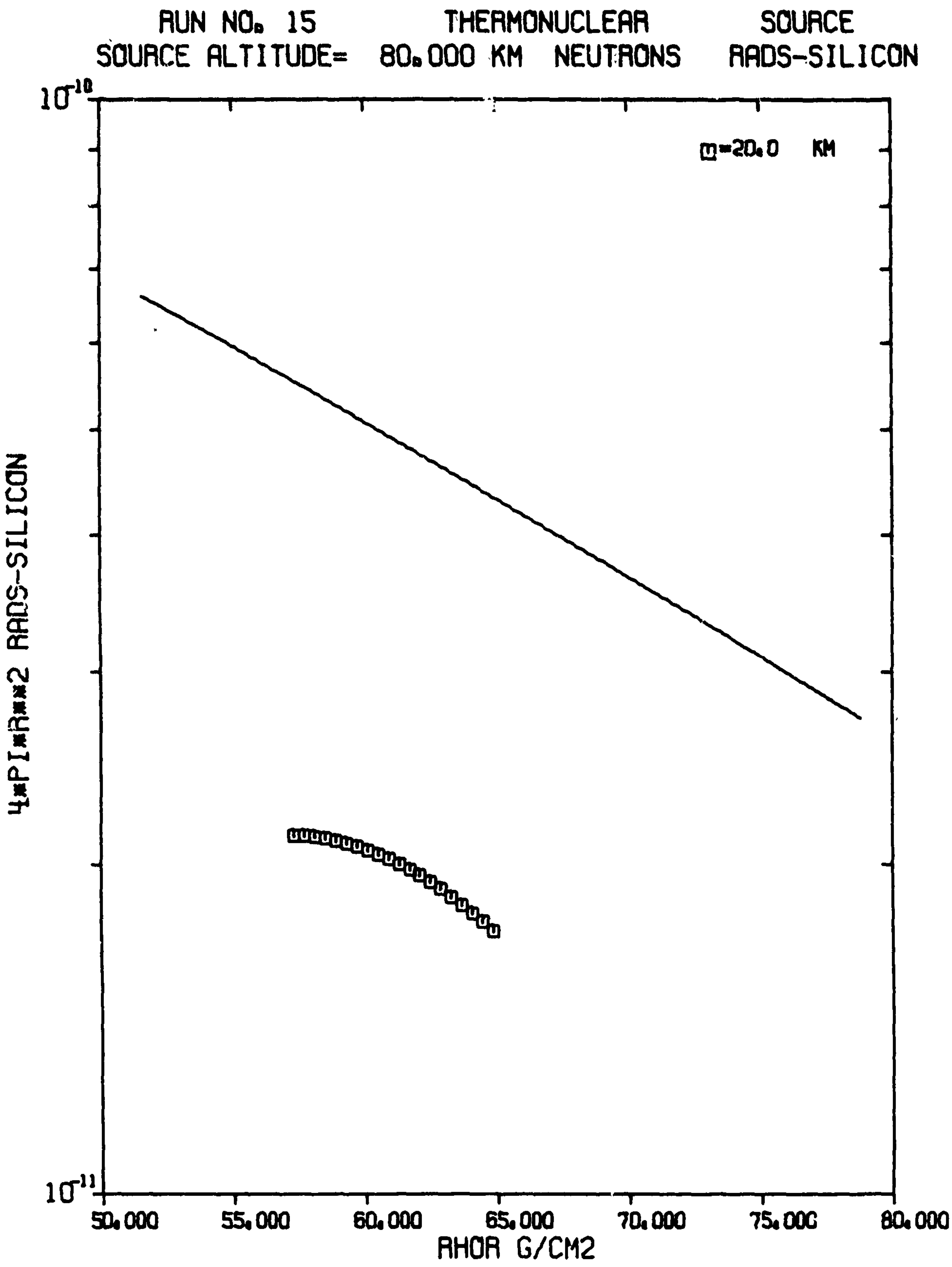


FIGURE 5-73 MORSAIR FIT DATA-4PIR**2 NEUTRON SI DOSE, THERMONUCL SOURCE IN REAL AIR AT 80.0 KM. SAMPLING ALTITUDES 20 KILOMETERS.

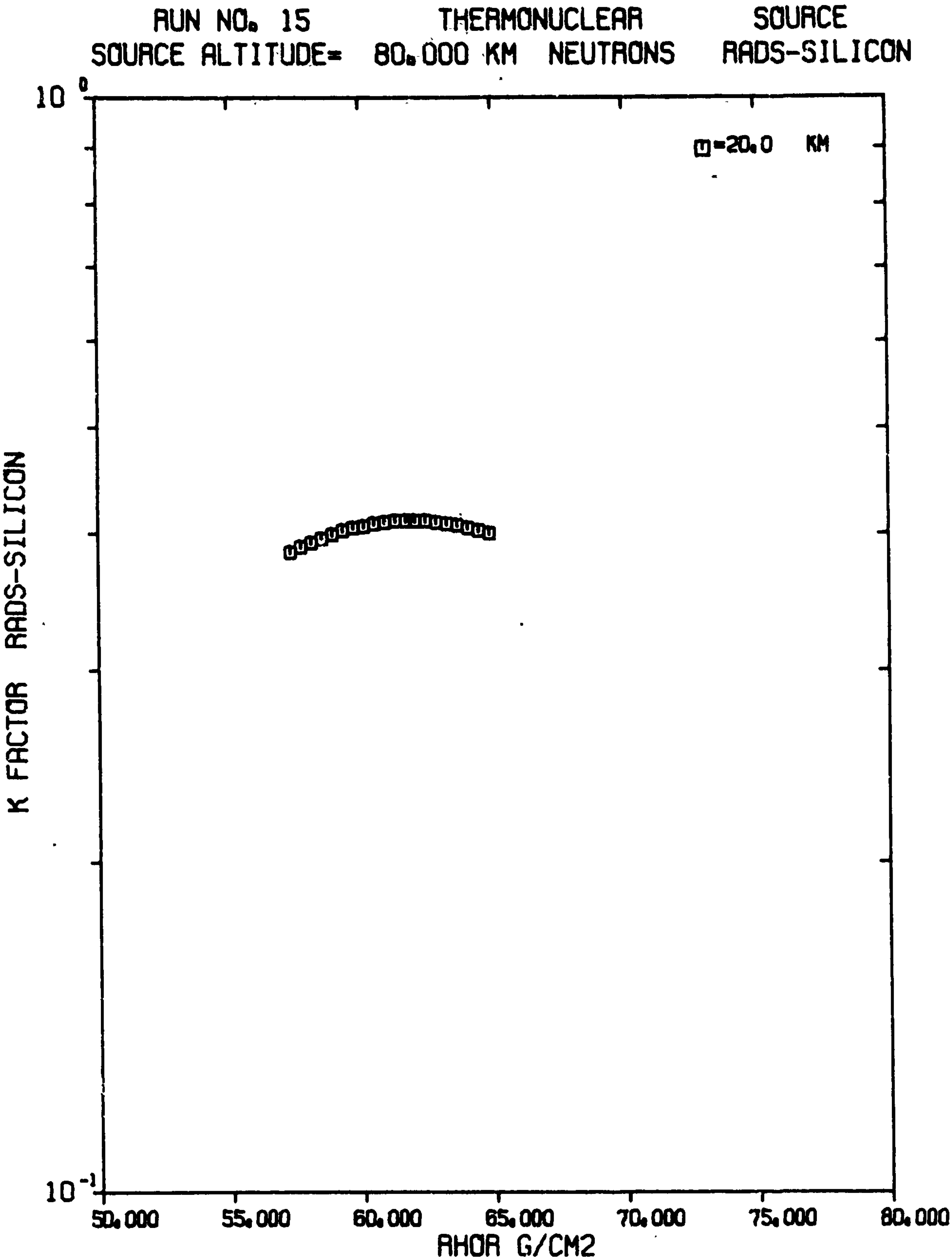


FIGURE C-74 MORSAIR FIT DATA-NEUTRON SILICON K-FACTOR
THERMONUCL SOURCE IN REAL AIR AT 80.0 KM.
SAMPLING ALTITUDES 20 KILOMETERS.

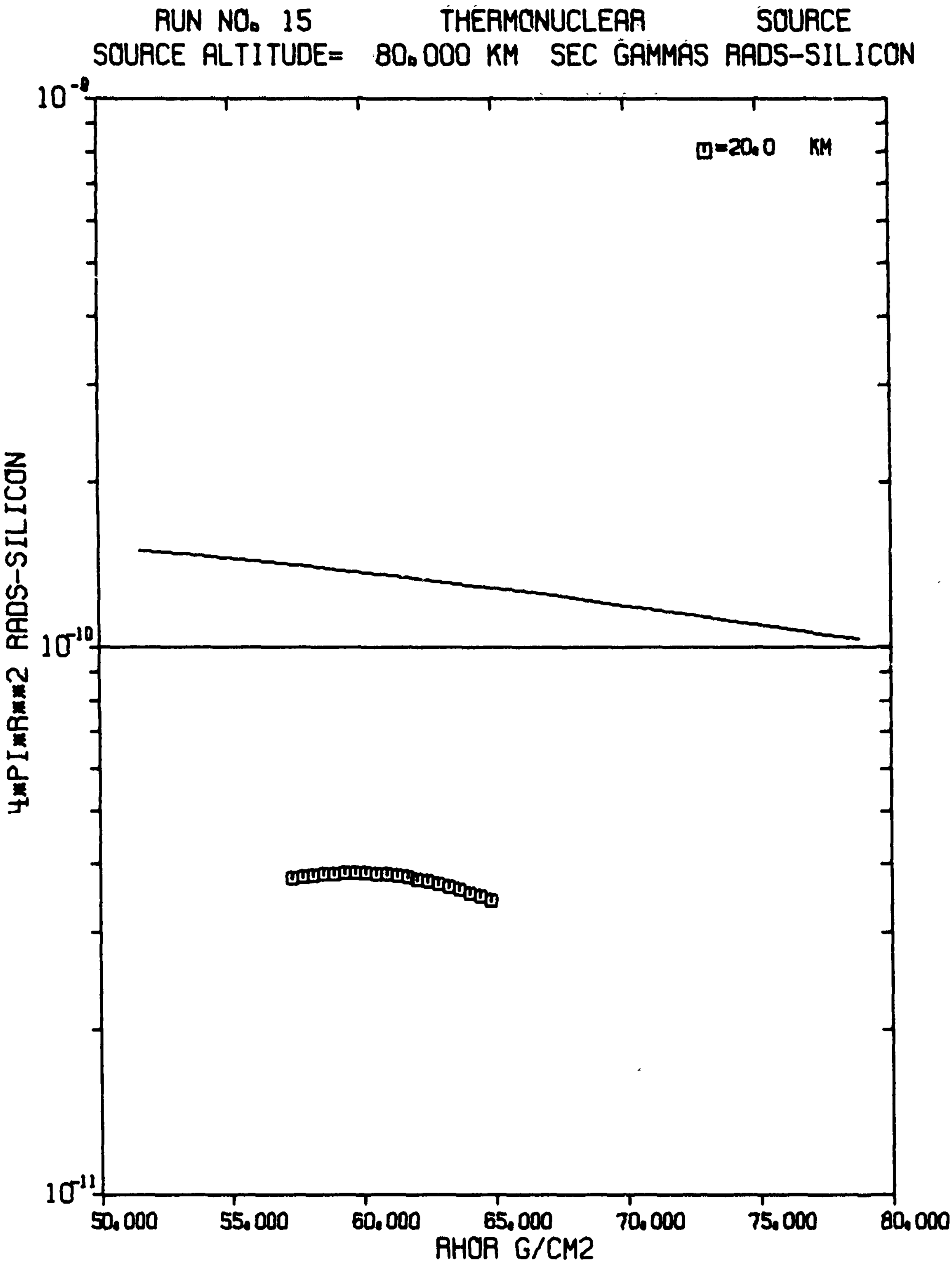


FIGURE C-75 MORSAIR FIT DATA-4PIR**2 GAMMA SI DOSE, THERMONUCL SOURCE IN REAL AIR AT 80.0 KM. SAMPLING ALTITUDES 20 KILOMETERS.

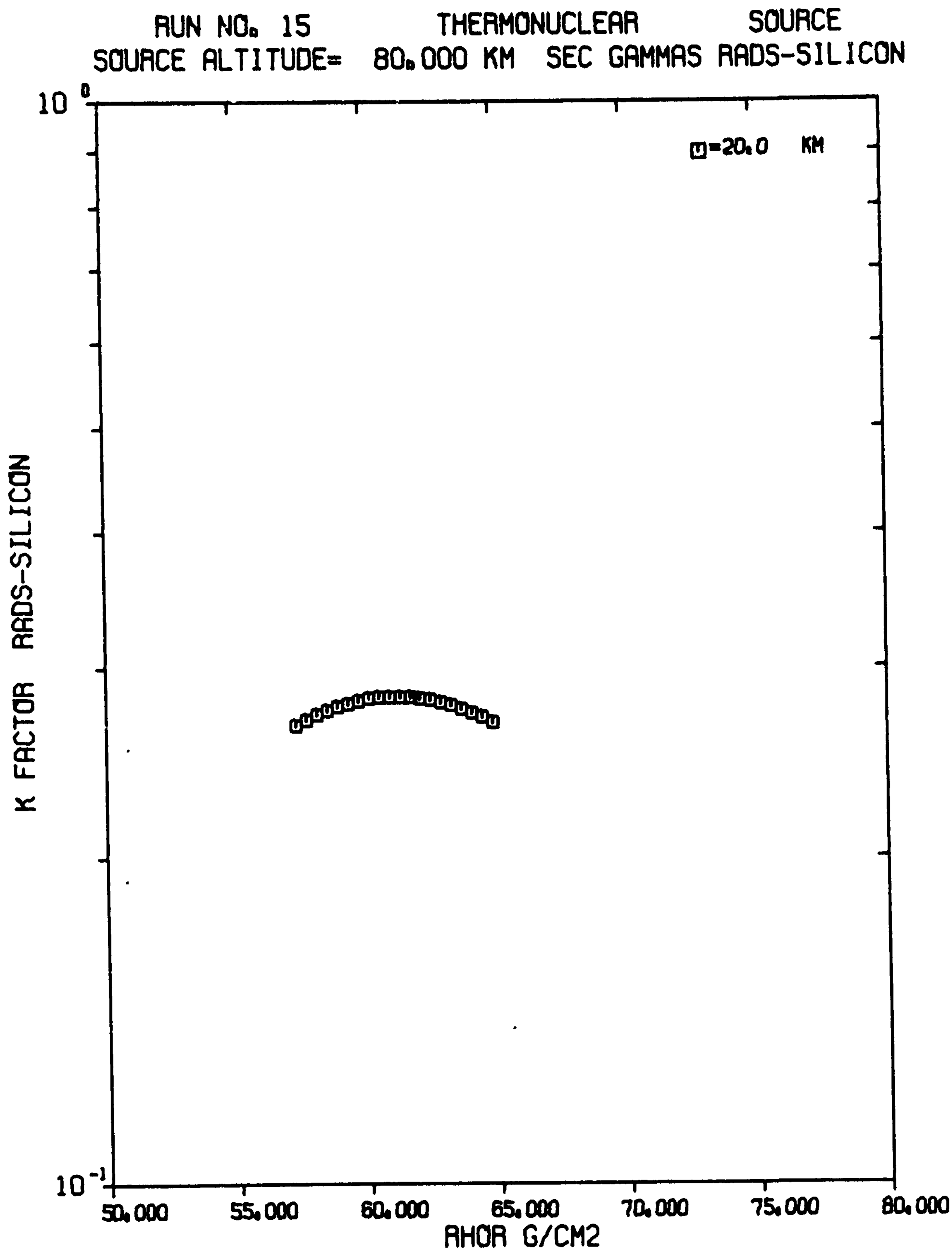


FIGURE C-76 NORSAIR FIT DATA-GAMMA SILICON K-FACTOR, THERMONUCL SOURCE IN REAL AIR AT 80.0 KM. SAMPLING ALTITUDES 20 KILOMETERS.

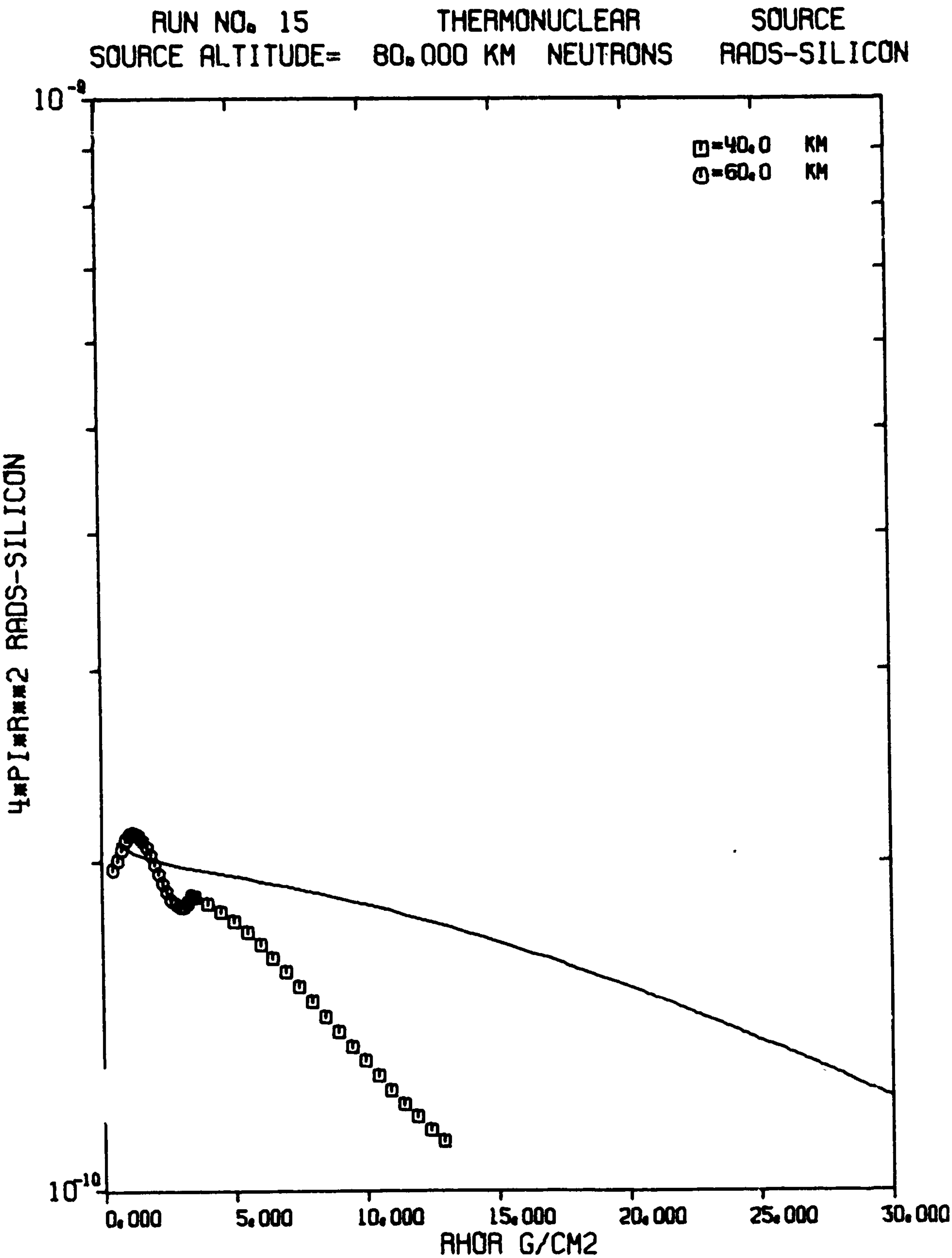


FIGURE C-77 MORSAIR FIT DATA-4PIR**2 NEUTRON SI DOSE, THERMONUCL SOURCE IN REAL AIR AT 80.0 KM. SAMPLING ALTITUDES 40 AND 60 KM.

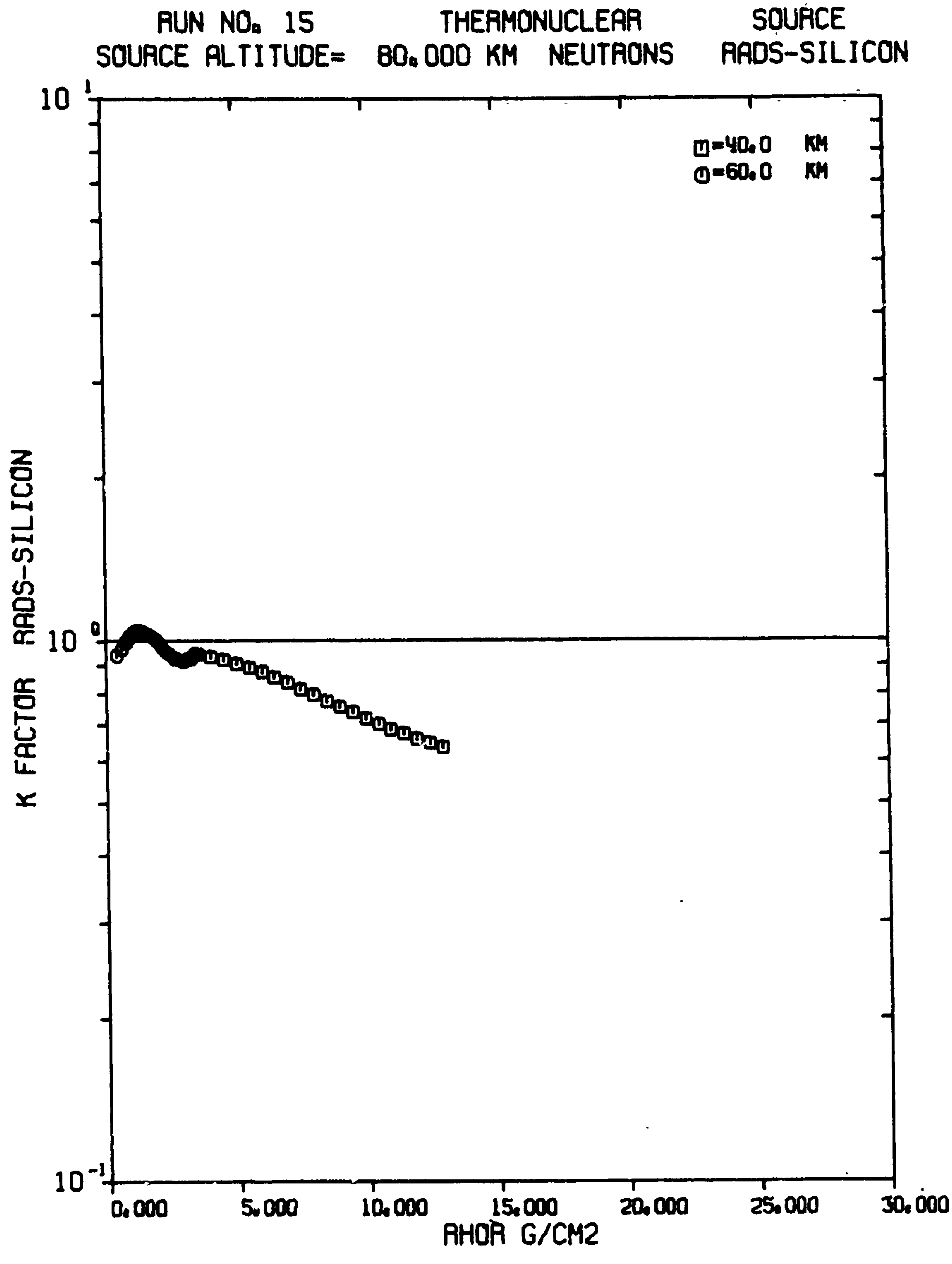


FIGURE C-78 MORSAIR FIT DATA-NEUTRON SILICON K-FACTOR THERMONUCL SOURCE IN REAL AIR AT 80.0 KM. SAMPLING ALTITUDES 40 AND 60 KM.

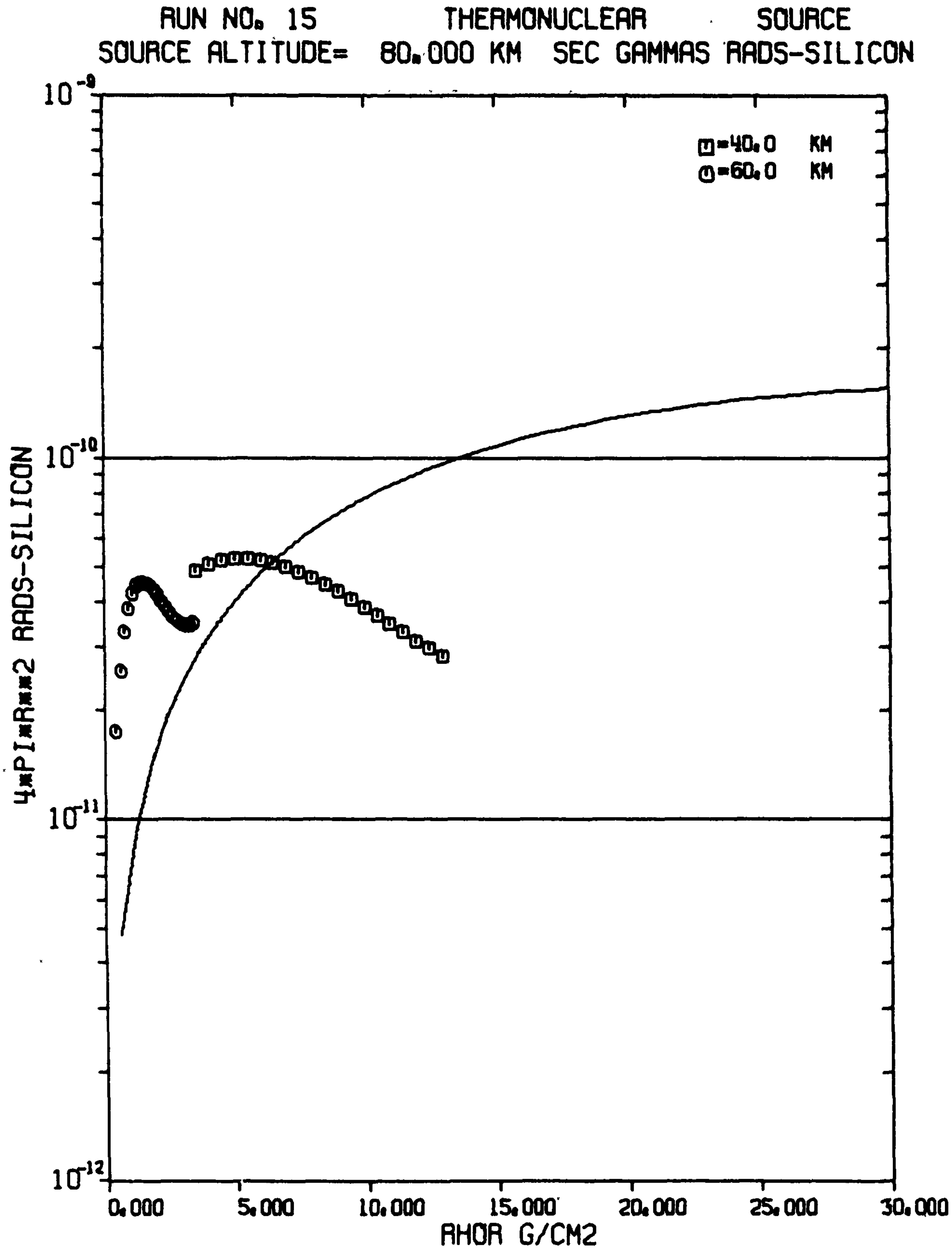


FIGURE C-79 MORSAIR FIT DATA-4PIR**2 GAMMA SI DOSE, THERMONUCL SOURCE IN REAL AIR AT 80.0 KM. SAMPLING ALTITUDES 40 AND 60 KM.

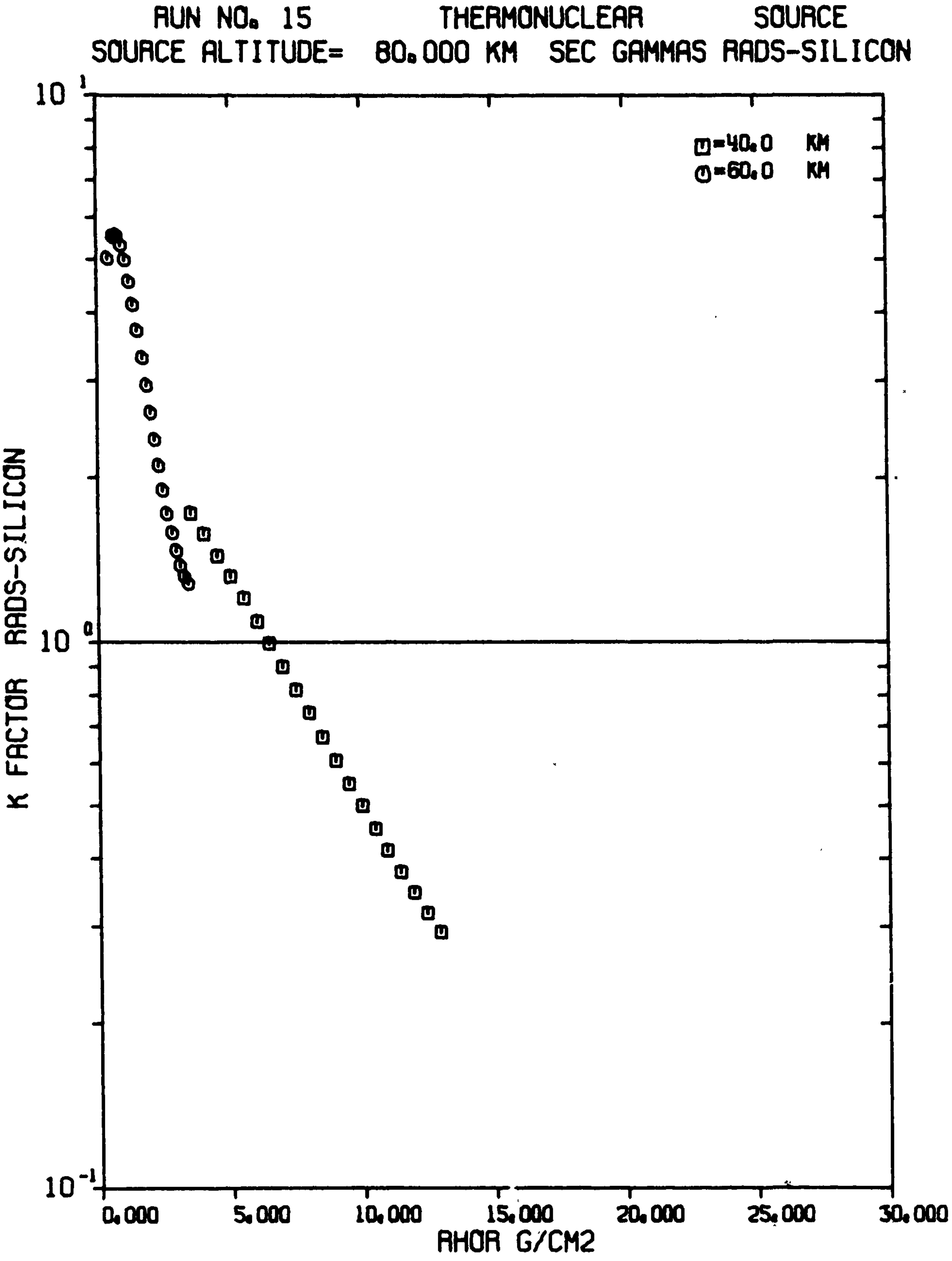


FIGURE C-80 MORSAIR FIT DATA-GAMMA SILICON K-FACTOR, THERMONUCL SOURCE IN REAL AIR AT 80.0 KM. SAMPLING ALTITUDES 40 AND 60 KM.

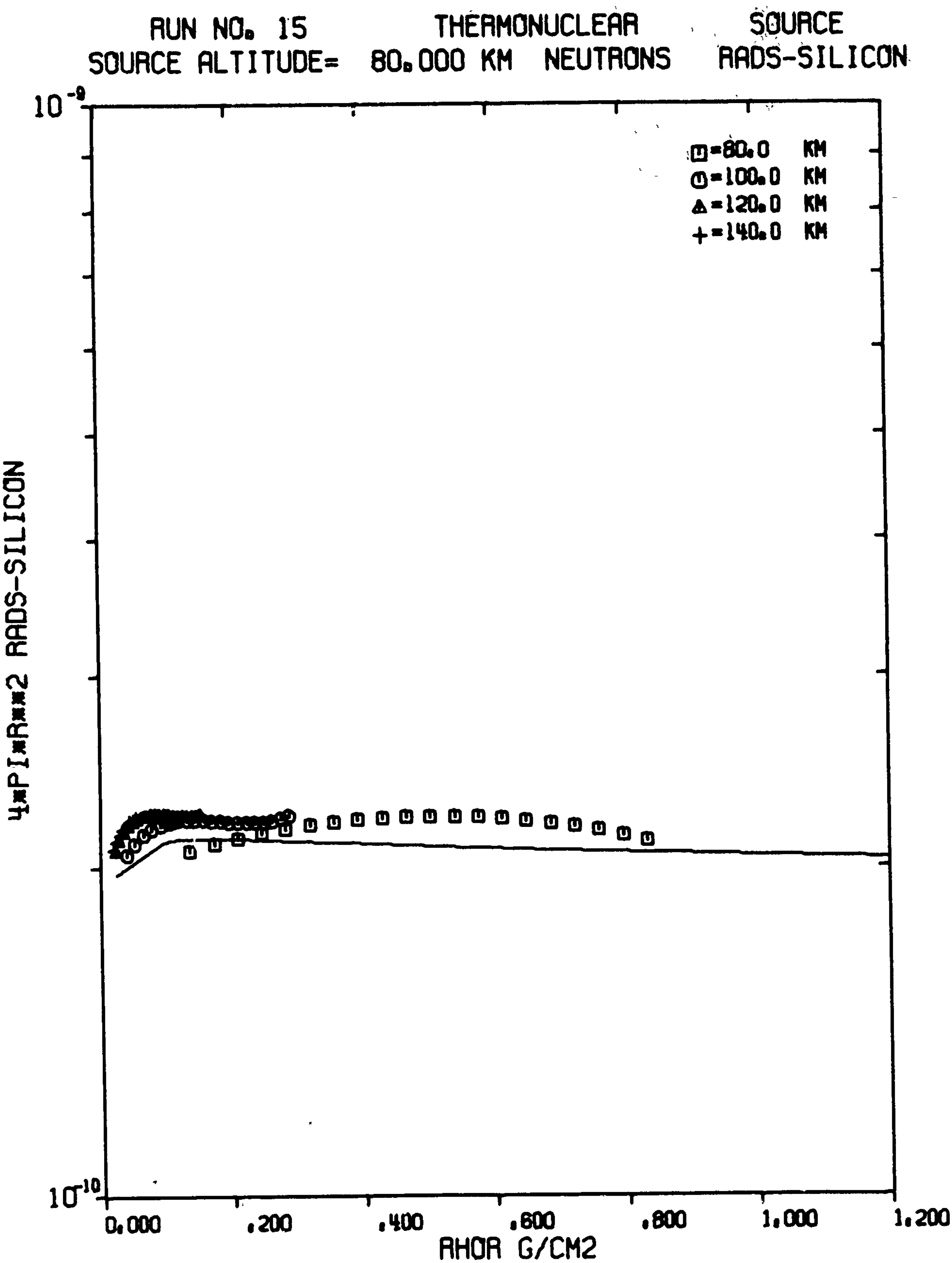


FIGURE C-81 MORSAIR FIT DATA-4PIR**2 NEUTRON SI DOSE, THERMONUCL SOURCE IN REAL AIR AT 80.0 KM. SAMPLING ALTITUDES 80,100,120, AND 140 KM.

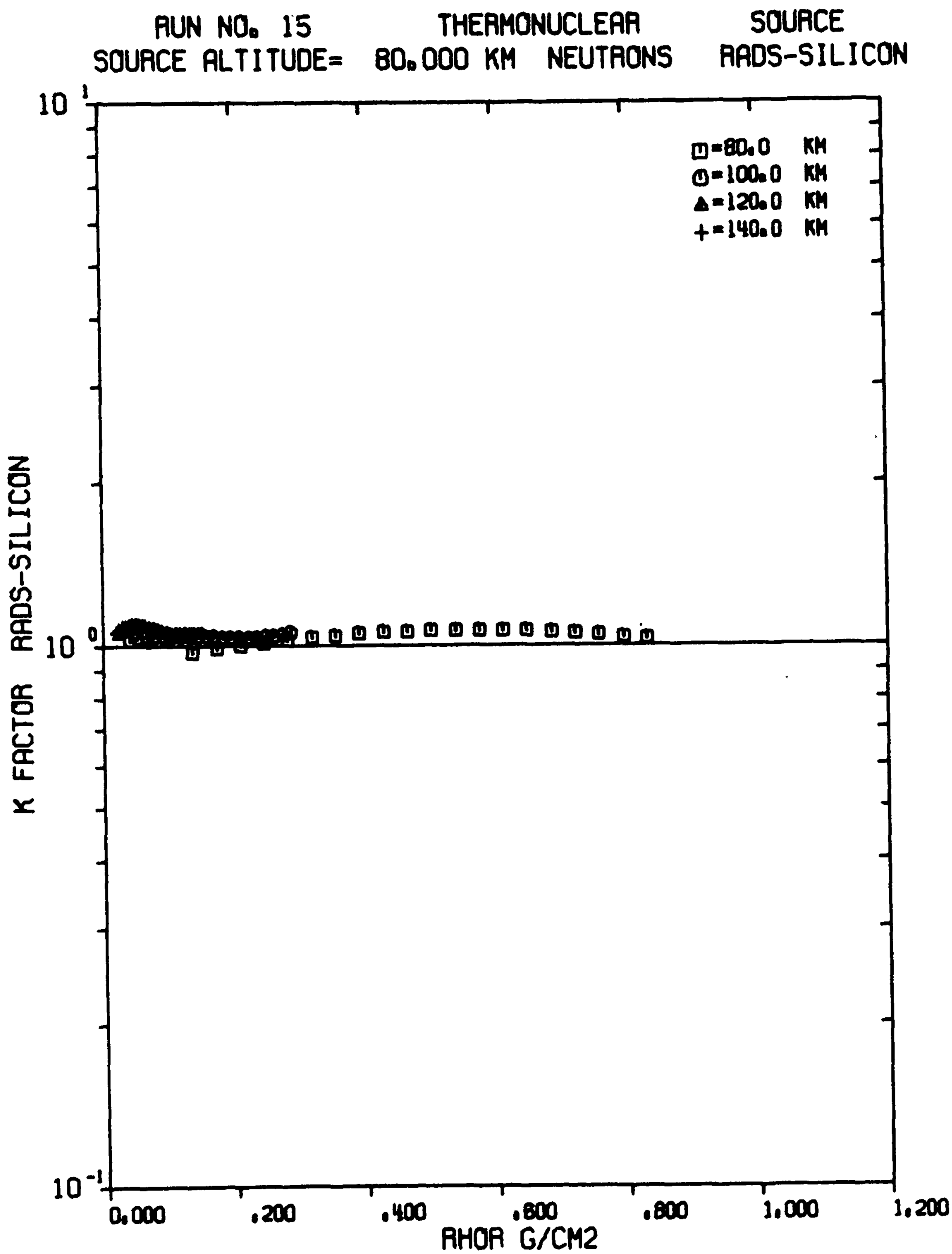


FIGURE C-82 NORSAIR FIT DATA-NEUTRON SILICON K-FACTOR THERMONUCL SOURCE IN REAL AIR AT 80.0 KM. SAMPLING ALTITUDES 80,100,120, AND 140 KM.

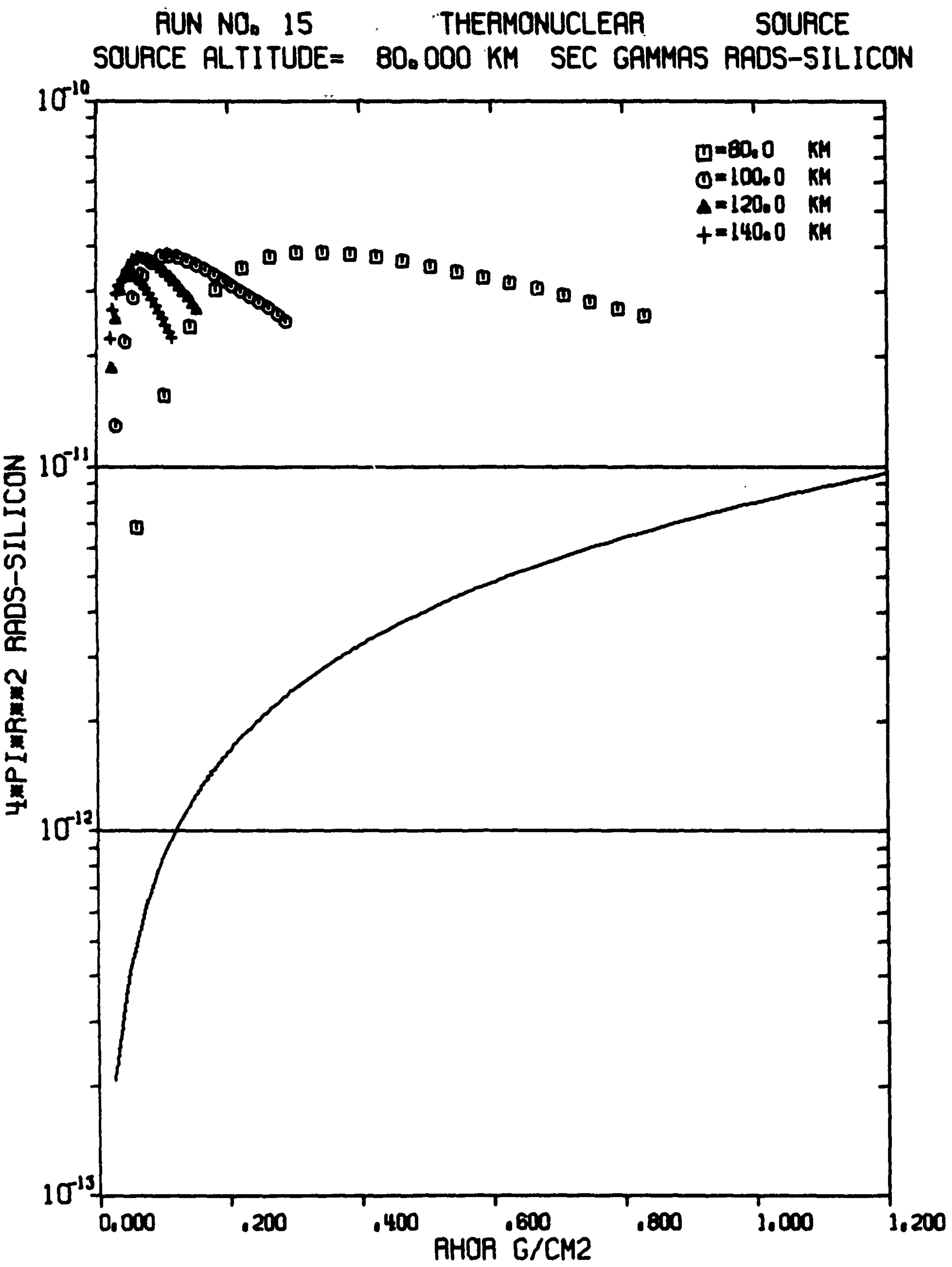


FIGURE C-83 NORSAIR FIT DATA-4PIR**2 GAMMA SI DOSE,
THERMONUCL SOURCE IN REAL AIR AT 80.0 KM.
SAMPLING ALTITUDES 80,100,120, AND 140 KM.

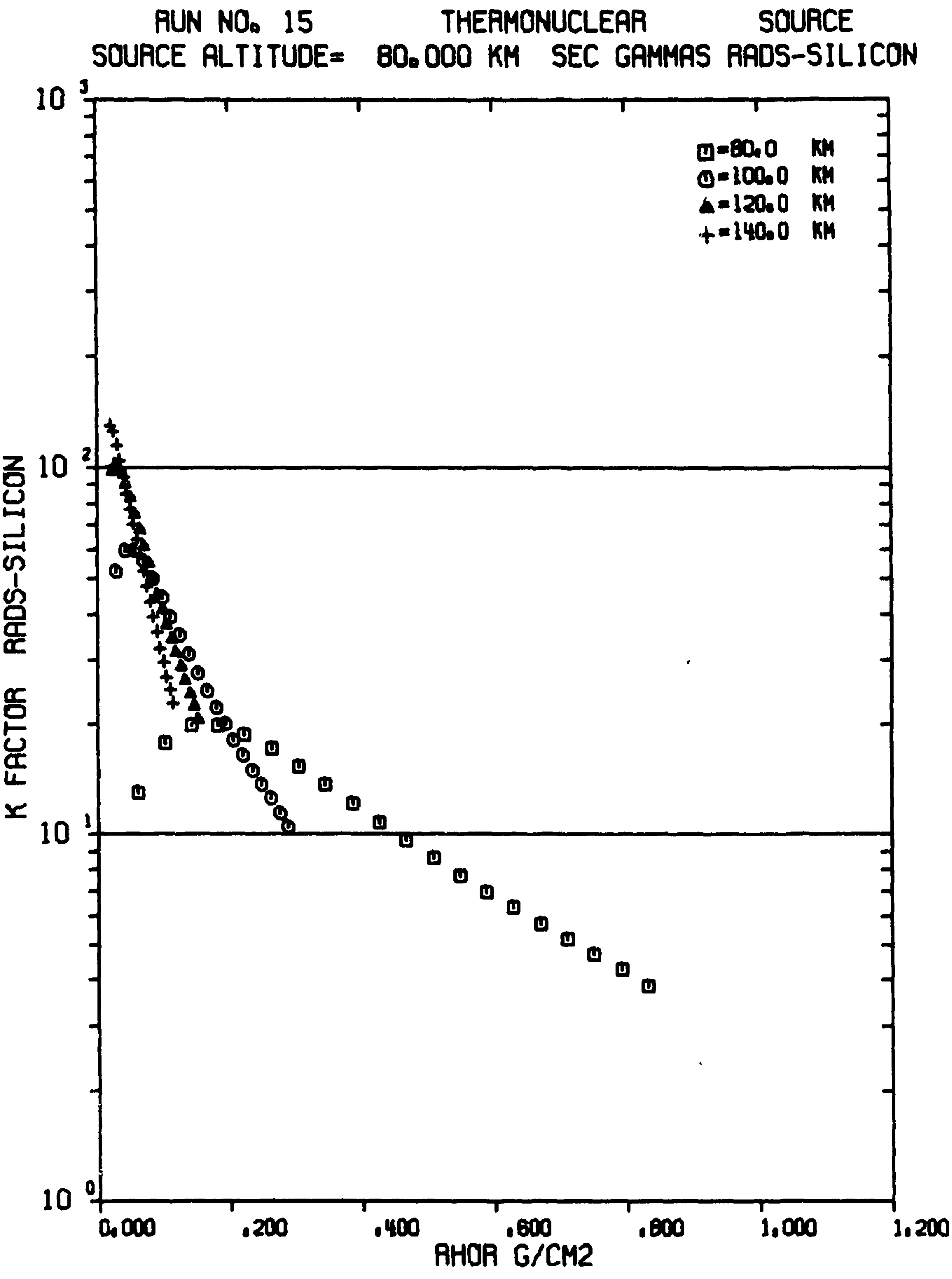


FIGURE C-84 MORSAIR FIT DATA-GAMMA SILICON K-FACTOR, THERMONUCL SOURCE IN REAL AIR AT 80.0 KM. SAMPLING ALTITUDES 80,100,120, AND 140 KM.